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ADVANCED MATERIALS

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ADVANCED MATERIALS

New Vacuum Plasma Spray Facility Juelich Operational

90CW0093A Duesseldorf HANDELSBLATT in German 20 Dec 89 p 23

[Text] With the official dedication of the vacuum plasma spray facility at the Institute for Reactor Development of the Nuclear Research Facility Juelich GmbH (NRF), another major piece of equipment was recently put into operation for work on applied materials research. It completes the equipping of the Institute. Work on materials development can now be carried out more intensively in combination with the major equipment already available, e.g. hot isostatic presses and other smaller accessory facilities.

The research and development programs of the Institute contribute to the NRF's key program on "heat resistant materials and structural ceramics." The plasma spray technique will be used in various ways within the framework of this program. In one respect, plasma spraying increases the technological potential for applying various types of surface coatings to high strength materials. This involves protective ceramic layers on metallic materials as well as the metallizing of ceramics for use in protecting against wear and friction. Corrosion resistance and thermal insulating properties of heat stressed materials should also be improved by this method.

The NRF sees a second group of applications for plasma spraying in its strengthening ability, if it is viewed as a competitive process for the production of nearly finished parts (Near Net Shape Technique). This involves spraying components in direct ready-to-use geometry without substantial additional finishing.

Ceramics Coated with "Heater Coils"

Because of the nature of plasma spraying, it is especially attractive for producing heterogeneous structures, i.e. combining materials of the most varied properties, e.g. composite materials made of ceramics and metals. Studies have already begun in this area, e.g. the manufacture of both superalloy and ceramic components and the combination of both types of materials.

In this context, the production of components by spraying of functional elements also plays a role. As a special example, the development of furnace structures is now being planned, in which, for example, an electrically conducting layer of lanthanum chromide, intended to assume the function of the heater coil, is sprayed onto a ceramic tile. This can be covered by additional sprayed layers. Even the spraying of metal matrix fiber reinforced composite materials should be possible with this method. Applications have already been demonstrated in America.

Work on the production of airtight seals is seen as a third area of application for the plasma spray facility. In the NRF a new method was developed which makes it possible to employ the plasma spray as an aid in joining components by means of hot isostatic pressing. In this method, the components to be joined are placed one on top of the other and the joint is made airtight by plasma spraying with a sealant appropriate for the material. This arrangement is then fixed and can undergo hot isostatic pressing directly. In this way, a diffusion bond is formed, making it possible to join materials which would otherwise be difficult to join, for example ODS alloys.

The facility installed in Juelich was provided by the Leybold Company, Hanau. It consists of a large vacuum tank of about 1.2 m diameter; the spray gun, which produces the plasma and powder jet, is moved by a six-axis robot. The piece to be sprayed rests on a two-axis robot which can be rotated and moved longitudinally. This system of movement permits great flexibility in spraying components with complicated geometries. The vacuum boundary conditions permit maximum cleanliness in the production of composites, especially when dealing with heterogeneous materials. Precleaning and heating of the workpiece using a transmitted arc is also possible. The entire spray process is monitored using process control which sets and regulates reproducible spray parameters. The pricipal spray gas used as a carrier gas is argon; admixtures of nitrogen, hydrogen and helium can also be employed.

Cooperation with Industrial Partners

All materials which have a melting point can be sprayed, i.e. if they can be converted from solid powders to a liquid state. The sprayed structure then has the properties of rapidly solidified materials: small grain size and a relatively high homogeneity. The porosity of such sprayed structures can be kept very small, although there are material-related problems here.

The NRF reports that, in the meantime, the facility will be used intensively and that there are a number of agreements and cooperative plans with internal and external partners, especially industrial partners, for joint projects.

AEROSPACE, CIVIL AVIATION

Escape Systems for Hermes Crew Described

90CW0085a Stuttgart FLUG REVUE in German Dec 89 p 90

[Article by Goetz Wange: "Solution for Hermes Crew Rescue"]

[Text]

Solution for Hermes Crew Rescue; Decision Has Been Taken for Crew Rescue System: Criticism Continues

"Ejection seat systems are now only being considered as a possible fall-back position. After comprehensive comparative studies, we have found the technical solution for

the Hermes crew rescue system," declared H. P. Nguyen as Aerospatiale's program manager at the 40th Congress of the International Astronautical Federation (IAF) in Malaga, Spain.

Essentially two solutions were up for debate. First, the so-called Crew Escape Module (CEM) Type B: An arrangement in which, in the event of emergency, the crew compartment area with the three astronauts can be separated from the spacecraft by igniting a 350-kN propulsion engine. The second solution is Type A: The entire front part of Hermes separates from the rest of the body section either by means of a propulsion system, housed in a turret-like cradle mounted on the Hermes nose, or by two 300-kN solid-fuel boosters mounted to the left and right of the crew compartment on the wing roots (lateral boosters). A third, solid-fuel engine, with an output of 80 kN, provides the propulsion in the re-entry phase.

The engineers' initial decision was in favor of Type A with the lateral boosters. Arguing in favor of this system is a weight advantage of about 280 kg compared with the Type A [as published; should read "Type B"] solution, although the total weight of 4,346 kg is still way over the originally envisaged limit of 3,000 kg. Any further weight reduction in the crew rescue system—and in this the experts agree—could only be achieved if substantial cutbacks were made in the safety requirements. Presently, system functioning is to be ensured both in the event of accidents on the launch pad as well as during the burn time of the solid-fuel boosters of the Ariane 5 launcher up to a speed of Mach 6.3 and an altitude of 55 km. And the return phase must be covered as well. Here the designers made their first compromises in the Type A variant selected. Instead of a speed of Mach 6 from the re-entry up until touchdown, only the range from Mach 3 to a lowest flight altitude of 500 m is covered. "All our investigations have shown that accidents are not very likely outside of this range. Viewed in this way, the safety of the overall system does not perceptibly decline," Aerospatiale manager Nguyen explained.

Whether in the final analysis the lateral booster solution is actually implemented, still depends on various imponderables. To date no wind tunnel tests have been conducted, and the ignition of two boosters in an emergency increases the risk of failure as compared with a system with only one propulsion source for separation. Also still technically unexplained is the jettisoning of the boosters in incident-free missions. The fact that the Type A rescue system does not cover the landing phase results in considerable cost expenditures during the qualification flights of the aerospacecraft in the atmosphere and in the subsonic zone. For these tests additional ejection seats would have to be installed for the pilots, which would possibly require adaptation of the forward part of the spacecraft.

Arianespace: Review of 80's, Prospects for 90's

90CW0103b Paris LE MONDE in French 10 Jan 90 pp 19-20

[Article by Jean-Paul Dufour: "Ariane's Decade"; first paragraph is editor's lead]

[Text] For the European company Arianespace, the decade of the eighties finished superbly. And despite rising competition, there is reason to be optimistic for the coming years.

"I think we should manage to remain the world leader in the civilian-satellite launch market through the end of the decade that is beginning." The morale of Mr Frederic d'Allest, president of Arianespace, as he contemplates the nineties is rock solid. With reason. But though the preeminence of the European space-transport firm is not in fact too likely to be imperiled in the short term (3 years), the American—but also Japanese, Soviet and Chinese—competition is honing its weapons.

For Arianespace, 1989 was a good year. The commercial exploitation of Ariane-4, the new—heavy—version of the European launcher, went off without a hitch and the company, which will celebrate its tenth birthday next March, has never been in better health. Its order book lists 32 satellites, as many as it has launched into orbit since its foundation. And, said Mr d'Allest on Thursday, 3 January when he presented his company's results, "prospects for signing 10 to 12 other contracts in 1990 are solid." Arianespace had sales of 3.79 billion French francs in 1989, for a bottom line of 130 million francs. Ten satellites were launched, with 7 rockets (6 of which were fired between January and August.) Among them was the largest commercial satellite ever launched, Intelsat-6 (4.24 tons) and, above all, the first craft of the brand new private Japanese space-telecommunications companies, JCSat and SCC, who chose Ariane for their inaugural launches. A choice reference! As a concrete expression of this glowing health, Arianespace was not afraid to order 50 Ariane-4s from European manufacturers last February—a contract worth 18 billion French francs, a world first in the civilian launch industry.

Meanwhile, American competitors were racking up setback after setback. Failures, technical problems, commercial difficulties: the private companies entrusted by former President Reagan, after the explosion of the Challenger shuttle in 1986, with relaunching "classic " rockets are finding it excruciatingly difficult to fulfill their mission. The first to trumpet its ambitions—the Martin Marietta Company, which produces the Titan line—did receive an order for 50 launchers from the army and announced 6 commercial contracts last June. But, Mr d'Allest asserts, it has not had a single commercial order for 2 years. Likewise, the Pentagon remains almost the only customer of the McDonnell Douglas Company and its Thor-Deltas: 21 of them (Navstar navigational satellites) for only 5 commercial contracts. Finally, General Dynamics, which produces the famous Atlas-Centaur line, intends to build and launch 62

rockets between now and 1997. It also enjoys solid military orders (11 rockets ordered) but has already signed 7 firm commercial contracts, including one with the Eutelsat Satellite European Communications Company.

A Serious Competitor

For Mr d'Allest, the Atlas-2, which will be able to carry payload of 2.5 to nearly 4 tons, may prove the most serious competitor for Ariane. The Titan-3s could also have been very dangerous, but the Martin Marietta Company seems to have decided to pull back and accord priority to the military market. As for the Thor-Delta, Mr d'Allest thinks that "it also is a very good launcher, but a bit exhausted technically, and McDonnell Douglas will have to make huge investments" to make it really competitive in the coming years. Unless the company confines itself to the ever-shrinking market niche of "small" 1,200- to 1,500-kilo satellites.

As for Japan, it underestimated the growth in satellite size: its LH-1 launcher (550 kilos of payload in geostationary orbit) is too limited in power, and the LH-2, which could compete with Ariane, will probably not be ready before 1995. On the other hand, a serious competitor has appeared in the East. The USSR is offering the services of its launcher Proton, which works like a clock and whose reputation is already established. But, Mr d'Allest estimates, "it has shown a few problems with reliability and precision of placement in geostationary orbit." In the Arianespace president's opinion, China, on the other hand, is a much more dangerous competitor. Its Long March launcher, whose architecture is comparable to Ariane's, seems destined for a brilliant career. Moreover, the Chinese have just received the export authorization from the American government essential for their launch, to be made shortly, of three American-made satellites.

The Chinese and Soviets worry Western rocket launchers because of the charges they propose. "Dumping prices that have nothing to do with the market," says Mr d'Allest. Americans and Europeans are presently trying to make their Eastern competitors accept "rules of the game" that would force them to respect "capitalist" laws of supply and demand. Failing this, retaliatory measures, such as, for instance, a systematic refusal to authorize the exportation of satellites, could be taken.

But none of this shakes the glowing optimism of Arianespace's president, convinced he will stay at the head of the pack for a long time in the battle for the launcher market. "The Chinese and Soviets may capture markets because of their dumping prices, but their launchers are adapted to their own programs and they do not have the same commercial criteria we do," explains Mr d'Allest. American rockets, which have proved themselves, are nevertheless derived from military missiles. And though the Pentagon, chief customer of private companies stateside, provides sure and regular income, its hegemony makes efficient management difficult—the flip side of the coin. The first commercial launch of a Titan-3, for example, last 31 December, was delayed to make way for military launches, which were accorded priority.

"In contrast," Mr d'Allest brings home, "we are the only ones in the world with a coherent product policy. Our major concern in developing Ariane launchers is that they match the needs of the customer, just like automobile makers." This concern can even be taken quite far: Ariane-5, the version that will succeed the current Ariane-4s, will not fly until 1995 at the earliest. But, Mr d'Allest discloses, "Arianespace has already set up a team that travels the world to present it to future customers, discussions are underway with satellite manufacturers, and the first launch proposals for Ariane-5, in anticipation of contract signings, could be drafted as early as next year."

ATR 72 Certification Reported

90CW0096B Stuttgart FLUG REVUE in German Jan 90 pp 94-97

[Article by Bernd Gaubatz: "Aircraft Report: ATR 72 Commuter Aircraft Certified—Length Is Strength"]

[Text] According to the notion that "stretched aircraft mean stretched profits," the new ATR 72 commuter airliner, a stretched and optimized version of the successful ATR 42, has entered the market. The airliner, a joint Italian and French development which recently received type certification, should be highly successful in the commuter market.

It all began eight years ago with a Groupement d'Interet Economique [economic interest group], or GIE for short. Italy's airline concern Aeritalia and France's Aerospatiale agreed to pool their know-how and expertise to jointly develop the ATR 42, a twin-engine turboprop aircraft for the commuter market; the designation "ATR 42" stands for the 42-seat Avion Transport Regional [aircraft for commuter transport].

The two companies had agreed that Aeritalia would develop the complete fuselage including the tail assembly, and would also install the landing gear. The air conditioning, hydraulic and cabin pressurization systems would be installed in Italy in every ATR as well.

France, on the other hand, promised to develop and manufacture the wings, cockpit and cabin internals, as well as to install the engines and the electrical and control systems. Finally, each civilian aircraft was to be test-flown under the aegis of Aerospatiale. Aeritalia, for its part, was given control over the assembly process as well as the military test-flight program—production of a military version had been planned from the inception of the program.

A short time after these development responsibilities had been assigned, production activities followed in rapid sequence. Two prototypes were developed, the first of which first flew on 16 August 1984, followed by the

second test aircraft on 31 October 1984. As soon as the end of April 1985, the first production aircraft began its maiden flight, and on 24 September the French aviation authority DGAC granted type certification as per JAR 25. The FAA awarded its type certificate simultaneously, and the aircraft has been certified here in the Federal Republic of Germany since 12 February of the year before last.

What could not have been anticipated eight years ago has since become fact: The ATR 42 has become a huge financial success. By March of last year, the ATR 42 commuter airliner, powered by two Pratt & Whitney PW120/121 turboprop engines, had logged nearly 250 firm orders and serious options, and around 130 aircraft had already been delivered by April.

Even in a well-designed aircraft there is room for optimization or even further development, and the ATR 42 is no exception. Approved development plans included stretching the fuselage, installing more powerful, more economical, quieter engines and installation of an improved avionics system. At the Paris Aerosalon in 1985, Aerospatiale and Aeritalia gave the green light for construction of a larger ATR which would carry from 64 to 74 passengers. This new version was also to be powered by Pratt & Whitney turbines, but instead of the PW120/121, the 2400 shaft HP PW124/2 was to drive a powerful and very quiet four-blade propeller with a diameter of 3.96 meters manufactured by Hamilton Standard.

ATR 72 FAA-Certified in November

However the new aircraft could not be designed by simply stretching the airframe; the wing span and surface area of the wings had to be adapted to the stresses of the new design. The first ATR 72 (F-WWEY) began its maiden flight on 27 October 1988. Just two short months later the second test aircraft was flown, in June of last year the third, and the ATR 72 received its French type certification on 25 September 1989. FAA certification also followed quickly: the Francoitalian joint venture has been certified in the US since 15 November, and the first aircraft went into service for the US airline Executive Air in Puerto Rico in December.

A magnificent achievement, considering that less than a year passed between the first test flight and certification by the Direction Generale de l'Aviation Civile (DGAC [General Civil Aviation Board]), and that during this time, 1036 hours of test flight were logged in those prototypes which were available. In order to set such a record, five aircraft had to participate in the homologation process, making a total of 603 flights. Even the first production aircraft—it was delivered to the Finnish company Karair on 27 October—was included in the test and certification phase, and flew for a total of 73 flight hours distributed over 67 flights.

The New ATR 72 Has Up To 74 Seats

The ATR 72 is four and one-half meters longer than the original model. The section of the airframe ahead of the wings is 2.91 meters long, while the rear section has a length of 2.31 meters. This increased the overall length from 22.67 meters to an impressive 27.17 meters.

The seat mounting rails in the fuselage of the ATR 72 can accommodate up to 74 seats, although the cabin is somewhat cramped in this configuration. The basic model with 66 seats is a good deal roomier. The ATR 72 has a wing span of 27.05 meters—2.48 meters more than the 42. The wing surface area was also increased from 54.5 to 61 square meters. The load per unit area increased from 306.4 kilograms per m^2 to 327.7 kg in the basic configuration, and 352.5 kg in the special version.

These increases are easy to understand, because the moderate increase in the size of the ATR 72's wings must now support a considerable increase in the aircraft's dead weight and the weight of its cargo. Thus, the weight of the empty aircraft increased from 10,285 kg to 12,200 kg, and the maximum load capacity went from 4195 to 7180 kg. The maximum takeoff weight (MTOW) increased from 16,700 to 19,900 kg. These are the figures for the basic model.

The main landing gear system and the brakes also had to be adapted to these higher loads. The nose gear, on the other hand, was not modified. However it was not only the weight which increased—thanks to the Pratt & Whitney turbines used in this model, performance also increased. While the ATR 42 is capable of a maximum cruising speed of 207 knots, or 495 km/h, the new ATR 72 achieves a speed of 286 knots, or 530 km/h. With the torque and propeller speed levers in the economy flight position, the aircraft can still attain a speed of 248 knots, or 460 km/h.

The maximum ceiling, however, has not changed: for the ATR 42 and 72, the maximum ceiling is 25,000 feet, or 7620 meters. In single-engine operation, however, there are differences between the two: While the ATR 42 can reach a maximum ceiling of 2515 meters under standard weather conditions (ISA) of +10°C and at 97% of its MTOW, the basic ATR 72 under identical conditions can fly at a maximum ceiling of 3385 meters.

Due to the higher overall weight, of course, the 72 requires a somewhat longer runway for takeoff and landing: Under maximum load and ISA conditions, the ATR 72 needs a 1270 meter-long runway for takeoff, but only 1010 meters for landing. Nonetheless, these are excellent figures, considering that the stretched ATR 42 can take on a considerably greater cargo weight and has "only" an additional 600 total shaft horsepower available for takeoff.

The ATR 72 Cockpit Uses "Dark Cockpit" Philosophy

In the design of its cockpit, the ATR 72 profited from the already existing designs of the Airbus A 310 and ATR 42

cockpits. In order to minimize the load on the crew, practical use was made of experience gained in ergonomics and safety-related areas. In addition to audible warnings, the Centralized Crew Alerting System (CCAS) employs different colors to alert the crew to system malfunctions or failures. In addition, three functions have been assigned to each switch: an indicator function, a warning function and an operating function. The "Dark Cockpit" philosophy is also in evidence in the "command center" of the ATR 72. "Dark cockpit" means that the instrument panel is completely dark when all systems are operating properly.

In the final analysis, the performance figures of the jointly-developed ATR 72 certainly indicate that the French and Italian partners have a knack for detecting the flow of the commuter market, as well as its trends. And the fact that their customers think the same way is shown by the orders received to date. The overall number of orders increased from 220 to around 410 (November 1989) in the shortest time. ATR-family aircraft are now in service for 44 airlines. It is thus by no means far-fetched to think that by the year 2000 the 1000th order for an ATR may well have been received.

AUTOMOTIVE INDUSTRY

Progress in Hydrogen-Fueled Engine Studies

90CW0098 Duesseldorf HANDELSBLATT in German 2 Jan 90 p 13

[Article by Martin Kesten: "Liquid Hydrogen Stores More Energy"]

[Text]

Hydrogen as a Fuel—Tests Under Way; Use Poses Problems

It is the opinion of specialists in various camps that only by giving up our traditional hydrocarbon-based sources of energy will we be able to arrive at a long-term solution to the ecological problems of a steadily increasing world population. These sources must be replaced by new solar energy resources, for which hydrogen will be the most important energy carrier.

For several years, scientists have been seriously investigating the use of hydrogen as a fuel for earth-bound vehicles, and have been conducting experiments using test vehicles. Research institutes, vehicle manufacturers and the gas industry are working on technically feasible solutions.

In addition to adapting today's highly-developed internal combustion engines to the new fuel, the most difficult problem to be surmounted is the storage of sufficient quantities of hydrogen on board the vehicle. Due to the extremely low density of hydrogen in all of its aggregate forms, all feasible solutions to the problem represent either larger or smaller steps backward in comparison to the conventional fuel tank.

The storage of hydrogen in gaseous form at room temperature requires high-performance compressed-gas containers which are particularly light in weight. The storage capacity with respect to weight of fiber-reinforced composite material tanks is certainly large enough to warrant consideration; in all cases, however, the major disadvantage of mobile compressed-gas storage is its high specific volume. It is therefore suitable only for vehicles which can accommodate a sufficiently large tank volume, which is greater than that required for hydrocarbon-based fuels.

In hybrid technology, hydrogen is stored by temporarily binding the gas atoms chemically to specific metals, thereby forming metal hydrides which, depending on temperature and pressure, can absorb relatively large amounts of hydrogen in a small volume. Daimler Benz, in particular, has shown great interest over the past several years in the application of this storage technology in the motor vehicle. In a fleet experiment which ran for several years in Berlin, the company was able to show that in principle, hydride storage tanks could be used in hydrogen-fueled vehicles. A serious disadvantage of hydride storage tanks, however, is high system weight. The resulting small storage capacity drastically limits the range of vehicles equipped with such systems.

BMW Starts Series of Experiments

The cryogenic storage of liquid hydrogen achieves by far the highest storage density. This technology is the closest in storage capacity to conventional fuel storage systems. In addition, the low temperature and the relatively high density of the gas in its liquid state offer advantages with respect to the operation of the internal combustion engine; cold hydrogen permits greater engine performance and a further reduction in the emissions of oxides of nitrogen.

The use of liquid hydrogen in vehicles is a subject with which the DLR in Stuttgart has been concerned for more than ten years. A short time ago, BMW initiated a comprehensive research program with the goal of developing liquid hydrogen-fueled vehicles up to the pilot stage.

Messer Griesheim developed and manufactured several different tank models for use in this program. The double-wall tanks employ vacuum super-insulation technology which limits the evaporation rate to approximately 2% per day—an exceptional achievement, considering the tank volume of roughly 100 liters and the low boiling point of hydrogen (-253°C).

Depending on the tank pressure at any given time, the engine can be run using liquified or chilled gas. This further improves fuel economy. If before turning off the engine the vehicle continues to be run on gas-phase hydrogen until the tank pressure drops, evaporation losses are prevented over a long period of time. Practical refueling stations are also a part of demonstrating the capabilities of hydrogen-fueled vehicles. Due to the danger inherent in the handling of liquid hydrogen,

mistakes must be prevented at the start of any refueling operation, and all refueling steps must be automated, with the exception of the attachment and removal of the refueling hoses: After a refueling line and a gas return line have been attached to the vehicle, several sensor-controlled purge and evacuation cycles are executed in order to clear the connection lines and couplings. The lines are then chilled and the tank filled. After temperature sensors in the gas return line indicate the end of the refueling procedure and the flow of liquid hydrogen to the vehicle is stopped, the connection lines are again purged to remove hydrogen before they are decoupled from the vehicle. Such systems are currently under development at Messer Griesheim.

Aachen Automotive Research Facility Described

90CW0127B Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 22 Jan 90 p 10

[Article by Peter Winandy: Twelve Aachen University Institutes Found Automobile Center]

[Text] In order to coordinate the various research projects in the automotive industry, 12 institutes of the Rhein-Westphalian Technical University in Aachen have joined together to form the Aachen Automobile Center Association (ACA). Totally independent of the working relations currently existing between industry and the individual technical university institutes, the association will generate new research-and development capabilities in projects involving several participating institutes.

It was noted on this occasion that the technical superiority that West German automotive industry enjoys over the GDR and other East European products does not justify particularly great hopes. Rather, it may be expected that the marketing opportunities in those countries will result in increased competition among automobile producers on the world markets.

At the opening of the Rhein Westphalian Technical University's automobile road test tract in Aachen, the Rhein Westphalian Secretary of State Dr. Gerhard Konow expressed the wish to see an automobile "with social rather than 'olympian' attributes, that will consume substantially less fuel, last longer, be environmentally- and recycling-friendly, and be capable of mass transportation at great distances." This 480-meter long and up to 22.5-meter wide test track, with a circular platform having a diameter of 100 meters, as already briefly reported on 13 October, was built to test and improve automobiles, trucks, and buses. A 600-meter long and up to 89-meter high soundproof barrier, together with the use of large amounts of former construction ways, have satisfied the requirements of environmental protection as well as making it possible to collect up to 700 cubic meters of precipitation per hour and returning it immediately back to the ground water after it has been filtered.

As institute director Professor Doctor Engineer Juergen Helling explained, engines, power transmission, chassis, body, and vehicle electronics are mostly emphasized in research. Any change in the policy of cooperation of automobile producers in all parts of the world would result in increases in the development costs for the suppliers. Research and development projects would become more complex, and the need for external technological capacity would grow. Helling, in this regard, pointed to the development of the City Bus generation made from fiber compound materials and the Carbon Bus with it hydropulse technology as steps to managing the ever increasing traffic situation.

Besides Aachen University's Automotive Institute, 11 other institutes in the machinery manufacturing, electronics, and mining/metallurgy departments are engaged in the development of the car of the future. The Aachen Automobile Center also participates in the European "Prometheus" research project. "Prometheus" stands for Program for a European Traffic with Highest Efficiency and Unprecedented Safety. The goal of the participants from 17 automobile manufacturers and about 300 researchers is to make traffic more efficient through their own efforts by 1994.

Renault Plans Added Work Shifts To Increase Productivity

90CW0108A Paris L'USINE NOUVELLE in French 7 Dec 89 pp 27-28

[Article by Anne Ravilly: "Auto Construction: Third Shift Time"]

[Text] More production from more extensive use of equipment: like its European competitors, Renault is considering a three-shift schedule for its Flins plant. This implies new work schedules for the builders as well as for their suppliers.

In the wake of General Motors, Ford Europe, and BMW, Renault will also adopt a three-shift schedule for its auto assembly, beginning with the Flints plant. This new organization should start in 1991, when the production of the new R5 version (X57), which was launched in the spring of 1990, will have to be brought up to speed. As a result, Flins expects to increase its production capability from 1550 to 2000 cars per day by increasing the utilization hours of its assembly lines.

But this revolution, involving schedule changes as well as night and weekend work, cannot be carried out without preparing the workers' attitudes. The future three-shift organization is currently under negotiation between management and unions at Flins: it will require new hiring, and make an appeal for volunteers. It should allow production lines to run 24 hours a day, avoid various shop bottlenecks (painting, for instance), and respond more efficiently to the demand of a market that has been steadily growing for the past five years. Not to

mention the obvious advantage of faster amortization of the heavy investment associated with the launching of a new model.

The use of a third shift is not new in Europe. Since 1988, General Motors has been operating with three shifts at one of its Anvers plants in Belgium, which runs 24 hours a day including Saturday, with two 10-hour shifts; the workers take three days off after four days of work. "An innovative organization which gives the men more spare time, is less tiring, and provides greater flexibility," says Robert Eaton, president of General Motors Europe. In Zaragoza, where General Motors is manufacturing the Corsa Nova, the introduction of a third night-shift has led to an output of 1500 cars per day and has created 1000 additional jobs. In turn, Ford Europe announced to its unions this summer that in the near future it expects to start working round the clock, seven days a week and 24 hours a day in its European plants. This seems to be inescapable when Japan's Toyota clearly announces that it will work nonstop as soon as it begins production in its British plants, an advantage it gained by recognizing only a single union for representation.

Europe Adopts Flexibility

More surprising yet, BMW in West Germany has reached an agreement with the powerful IG-Metall union to operate three shifts at its Ratisbonne plant 24 hours a day, six days a week, as long as overtime is paid back in leave time. An unquestionable victory for greater flexibility on the other side of the Rhine. And thus customs slowly change.

In France as in Italy, automobile plants have never used night work until now. Fiat works two shifts at all its plants, including the one at Cassino; Peugeot and Citroen resort to overtime when the demand becomes too great and they have to speed up for a specific length of time. Guy Perrier, director of the Sochaux plant does not conceal that "it is the goal of any intelligent manager to make the most profitable use of equipment and that he has plans in this respect." It means that positions will have to be reassessed: some unions, like CFDT [French Democratic Confederation of Labor] and CGC [General Confederation of Managerial Personnel] are realistic and not totally opposed to evolutionary change, as long as the reorganization allows the creation of new jobs.

While these changes involve personnel realignments, they also require solutions to technical problems, such as the maintenance of machinery being operated around the clock. "It's currently not a handicap," the directors say, "since maintenance is increasingly of a preventive nature, with little stoppage; moreover, computerized systems work better when they run all the time." But in an industry that works under critical path conditions with many outside suppliers, how does an internal reorganization reverberate on satellite companies? For instance, would Renault Flins' suppliers be able to adapt to this new pace without too much trouble?

Many suppliers of parts to the auto industry are already working in three 8-hour shifts. Some of these are Glaenzer-Spicer, Ford Bordeaux, or the SMAE plants near Metz, which supply universal joints, engines, and gearboxes. Exceptionally, Michelin is already working around the clock at its Cholet and Tours plants. Bertrand Faure (interior equipment) explains that thanks to his various plants, he will be able to accelerate his deliveries. Plastic Omnium or Valeo have strong backs and will be able to withstand these new demands. But how about the small suppliers? Will they have the means to manage their production differently without additional investments or without a night shift? Lastly, this new organization is sure to affect the distribution networks that deliver parts or finished cars to dealers. Zero stock makes its own demands! But despite its problems, this evolution appears to be irreversible.

For Raymond Levy, Regie Renault CEO, it's a survival strategy. While the American market is experiencing enormous difficulties, in recent years the European automobile market has become an Eldorado coveted not only by European manufacturers and by such American giants as Ford and General Motors, but also increasingly by the Japanese.

Joint Strategy Against Japan

To win the battle, all the manufacturers adopt the same strategy, the one that has allowed the Japanese to penetrate all the markets. A competition that requires the best prices, fast model renewal, and quality improvements; these are constraints that demand constant productivity increases in their plants, and the process becomes more difficult each year.

Having cut back to a minimum the prices of parts from sub-contractors and equipment suppliers, and having adopted critical paths to eliminate stocks and delays, manufacturers can only extend the utilization of their machinery in order to improve their yield. As we recently learned from the Peugeot conflict, there is no possibility of asking the workers to tighten their belts during this growth period.

The last card in their hands therefore, is to accelerate the amortization of the very expensive installations (robots, automation) currently operating on most assembly lines. For the XM alone, for instance, Citroen spent 6.3 billion francs in Rennes to outfit is production plants, and Peugeot invested almost an equal amount at Sochaux to launch the 605. Which leads us to believe that the establishment of a third shift for Renault at Flins has a good chance of spreading to the other French auto manufacturers by 1995.

Peugeot's VERT Electricity-Powered Car Program

90CW0112A Paris LE POINT in French
1 Jan 90 pp 50-51

[Article by Jean-Pierre Adine: "The Appeal of Electricity"]

[Text] In three years, an electric car that produces its own power might revolutionize automobile transportation. Using a gas turbine and an alternator. That's

Peugeot's VERT program. Progressing from the electric-205's self-supporting 120 kilometers, to the unlimited range of the "dual-mode" vehicle.

For the past hundred years everyone's been trying to find a substitute for the good old internal combustion engine! Think about it: the old clunker needs pistons, connecting rods, and a crankshaft to convert an alternating motion into a rotating one. That's terribly complicated! And what's more, it pollutes.

Remember the oil crisis? We searched everywhere to find an alternative to the gas guzzler. The electric car for instance. We took a look; no dice! But today, when pollution control is imperative and some cities—Athens, Milan, Los Angeles for instance—have no other alternative than a pure and simple traffic ban, we're once more thinking about electricity.

Which manufacturer will dare add it to its line of cars? Anyone? Yes, the PSA group will. For years they have been quietly working on it, and it has not been easy. "We've been toiling in the wilderness; no supplier had in its catalog the techniques or the products we needed," reveals Jean-Yves Helmer, head of the auto division. The first utility vehicles (Peugeot J5 and Citroen C25) are now coming off the line. In April they will be joined by an all-electric 205. A miracle: this little car retains all its roominess because the bulky batteries, as well as the motor and its accessories have been tucked under the hood. And it runs.

No gearshift, two pedals, a soft purr, fast pickup, and the liveliness of a tired 2CV (minus the noise). It moves along at 100 kilometers per hour, silently, but if you keep your eyes on the ampere-hour gauge on the dashboard, you will find your adrenalin running as well. The figures drop with the kilometers: each minute seems to eat up the battery charge.

In short, 100 to 120 kilometers of autonomy is very little. And since the batteries need a good 8-10 hours to recharge, you are limited—absolutely—to urban driving. PSA's first customers are Electricite de France and if all goes well, the City of Los Angeles. But what about the rest of us? Why should the fans of electricity not entertain the hope of someday driving from Paris to Lille, or even to Lyon? It's with them in mind that the PSA engineers asked themselves the essential question: "What if, to all eliminate mileage limitations once and for all, our car produced its own electricity?"

It is the question that gave rise to the VERT (for Turbine-Electric Road Vehicle) program. How does it work?

You install four small electric motors, one near each wheel and you have already reinvented the 4X4. With a dash of electronics you "treat yourself" to non-skid wheels and anti-lock brakes, just like the big luxury cars. Batteries to feed the motors. Nothing new in all that, you say. Except that the batteries are supplied by an alternator, which in turn is driven by a gas turbine. The vehicle thus produces its own electricity.

On the road, the gas turbine—in theory less polluting, less complex, and more compact than the internal combustion engine—produces electricity through the alternator, running the four motors and charging the battery. In town, you turn off the turbine and switch to all-electric, running on batteries. Zero air pollution, zero noise pollution. When the batteries are "run down", you start the turbine and recharge them.

Why the devil was this contraption not invented sooner? After all, electric generators have been around for some time. Yes, but they have been driven by heavy diesel engines; here, it's the gas turbine that's new.

The turbine is as simple as they come: it takes in air, mixes it with any kind of fuel in a constant-combustion chamber, and sends the burned—and thus expanded—product through the blades of a turbine, whose shaft provides power and motion.

The advantages are compactness; the digestion of an ostrich (it burns equally well methane, super, gas oil, heavy oils, and even hydrogen); more controllable pollution; and reliability. With respect to the latter, aviation gas turbines run for at least 20,000-30,000 hours before they die, while an internal combustion engine gives up the ghost after 4000-5000 hours of good service.

But nothing is perfect. The high temperatures achieved in gas turbines affect its difficult and costly manufacturing. Moreover, they spin really fast (about 80,000 revolutions/minute, 12 times faster than conventional engines), which means that they can't possibly be connected to automobile wheels without extremely complicated reducers.

The turbine nevertheless interests PSA, which together with Mercedes, BMW, Volvo, and Volkswagen is carrying out another research program on this subject, Agata. The trick of the VERT vehicle is that its turbine is not intended to replace the internal combustion engine. It's only used to produce electricity, and therefore runs at constant speed. When the driver steps on the accelerator pedal, he does not draw on the turbine but on the battery output. And that's a significant point, since in this case the turbine can be extremely simplified.

It's also to simplify its task that PSA addressed itself to aeronautics suppliers: Microturbo (France), MKD (FRG), and Garrett (United States). Have you ever noticed, in planes parked with their engines turned off, the steady whistling noise from the rear of the plane? It comes from the auxiliary generator which is running to produce electricity. This auxiliary generator is nothing more than a gas turbine connected to an alternator, and it's the "gadget" that PSA wants to install in a car. It simply wants to take a shortcut, seeking to adapt that which is already available.

But even so, much remains to be done! The turbines have to be studied for noise; their efficiency has to be improved; they have to be insulated for heat; and their pollution has to be controlled below that of internal combustion engines. At the same time, buffer batteries will have to be developed; they will have to be powerful and small, and capable of rapid energy output rather than long-term storage.

Is this just a dream? Three years, only three years, is the deadline that Jean-Yves Helmer has given Claude Peyriere, head of the VERT program, for the first test-drive of a "dual-mode" vehicle of this type. That's pushing it. To speed things up, 115 million francs will be devoted to the "baby." Is this the end of the internal combustion engine? No. "We are convinced that in the future we will no longer have only one, but several types of propulsion." The "dual-mode" will be one of them. If it succeeds, this marriage of the turbine and electricity will perhaps be the first true response to the insolent supremacy of the internal combustion engine.

Researchers Seek Diesel Engine Improvements

90CW127A Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 11 Jan 90 p 8

[Article: Diesel Engine To Be Optimized Further]

[Text] A group of European researchers and leading automobile producers want to further improve the attributes and performance of the diesel engine within the framework of a common research project—Integrated Diesel European Action (Idea). At an international scientific forum sponsored by Heidelberg University, the researchers characterized the diesel as the engine of the future. It was portrayed as the most economical engine with the lowest fuel consumption. Moreover, the diesel can be made to operate even more smoothly, more economically, and more efficiently.

To accomplish this, however, the complicated combustion processes within the engine must be studied further. This task will be undertaken by the technical universities of the Federal Republic of Germany, France, the United Kingdom, Italy, and Spain, in cooperation with the automobile producers Fiat, Peugeot, Renault, Volvo, and Volkswagen. Volkswagen AG has assumed overall control of the project, which is being supported by the European Common Market and the automobile industry to the amount of 16 million DM.

While the combustion process of the internal combustion engine, (Otto engine) is thoroughly understood, some unknown processes still occur in the diesel. The fuel is injected into the compressed air in the combustion chamber and vaporized. This inhomogeneous mixture then combusts through spontaneous ignition. To examine the combustion process, Volkswagen AG, as reported, has developed a "glass diesel engine," in which quartz windows have been built into the pistons and cylinders. In this way, each step of the combustion process—fuel injection, spontaneous ignition, flame propagation, and pollutant buildup—can be observed.

On the basis of their observations and measurements, the researchers now want to develop an exact mathematical model of the processes in the diesel engine. By means of the model, improvements could be theoretically predetermined without the need for costly experiments. The particular interest of the basic researchers is directed to the causes of soot buildup in the engine, which contributes so much to the diesel's exhaust pollutants. The soot-buildup processes will likewise by simulated by computer modeling. In this way, the best possible diesel fuel/air and pressure/temperature mixture ratios will be determined so as to reduce soot buildup, without more fuel being expended or other pollutants being developed. The individual models will be integrated in a common computer program at the Imperial College in London.

Advances Made in Hydrogen-Fueled Engines

90CW0091 Leinfelden-Echterdingen EEE in German Nov 89 p 24

[Article by Walter Baier: "Hydrogen Engine for Automobiles"]

[Text] The automobile of the future likes to run hot ! Modern sodium-sulfur storage batteries for electric automobiles operate at 350° C. Hydrogen-fueled automobiles will possibly need an auxiliary heat source that generates 500° C. This is indicated by research undertaken by the Battelle Institute in Frankfurt at the request of the Hessian Ministry of Economics and Technology. Their basic premise for the undertaking: The development of hydrogen-fueled automobiles has not yet been satisfactorily completed. Naval tests with hydrogen-fueled automobiles conducted to date also change little in this assessment because their objectives were too narrow. So far, it has been more the technical feasibility of the hydrogen auto that has been studied, not, however, its attractiveness to the hoped-for buyers. Up to now, hydrogen-fueled automobiles have clung to the design of the gasoline-fueled auto. The question as to whether there are drive systems that are better suited to the hydrogen power source has hardly even been asked as yet.

Because of their low volumetric efficiency (amount of fuel in the cylinder), internal combustion engines using hydrogen yield only 70 percent of the power of comparable gasoline engines. Moreover, given the same tank capacity, a hydrogen-fueled automobile that has been modeled too closely after the gasoline-fueled vehicle, attains, at best, a cruising range of only 100 kilometers. Consequently, strictly speaking, it could only be considered a city car, whose range is only a little better than that of an electric automobile using lead batteries, and significantly less than that of electric automobiles using sodium- sulfur batteries.

These considerations are the starting point of the Battelle development. To attain a greater crusing range for the

hydrogen-fueled automobiles, Battelle is striving for an engine with the greatest possible efficiency and, at the same time, an improved "fuel tank" (hydrogen storage unit). Both ways help increase the cruising range. All in all, the Battelle researchers believe they can double it. If so, the hydrogen-fueled engine would be about on a par with an engine operating on sodium-sulfur batteries.

Internal combustion engines achieve about a 30 percent efficiency. On the other hand, combining fuel cells (about 60 percent) with electric motors (about 90 percent) results in efficiencies exceeding 50 percent. Hydrogen is therefore better utilized. To be sure, the power unit is more expensive than an internal combustion engine. Consequently, the most cost-efficient solution will depend primarily on the future cost of hydrogen. The higher the cost, the more favorable becomes the fuel cell/electric motor combination.

Even in the case of the so-called metal hydride storage batteries, which are preferred for safety reasons, improvements are still possible. On the one hand, they avail themselves of the circumstance that hydrogen atoms are so small that they can easily penetrate the crystal lattice of metals. Being so penetrated, many metals then form a chemical compound (hydride) with the hydrogen, in which energy is released in the form of heat. This compound again breaks up when energy is supplied (in the form of heat) and hydrogen is released.

That is the principle of hydride storage batteries, which release heat when "tanking up," but which require heat to release hydrogen. Depending on the metal, different temperatures are required. It is precisely the metals with the highest storage capacity that require the highest temperatures.

Thus, a problem arises for the fuel cell/electric motor combination. The internal combustion engine produces high temperatures in its exhaust gas, whereas the fuel cell/electric motor combination does not. Indeed, not even the exhaust gas temperatures of the internal combustion engine suffice to discharge the best storage metals. For this reason, the Battelle researchers have developed a power unit consisting of one high- and one low-temperature storage battery, as well as of a catalytic burner that produces flameless temperatures of up to 500° C. When an air supply switches on the burner, hydrogen is burned out of the low-temperature storage battery. In this way, heat is generated to discharge the high-temperature storage battery. The flameless, catalytic burning is not hot enough to produce any notable amount of nitric oxide; the conversion to heat occurs with a 99.9 percent efficiency. According to Battelle, the arrangement can only be used to generate heat, so that the entire stored hydrogen supply is converted into heat. Whether that is sensible is left open. For considerable amounts of heat also arise when tanking up the hydrogen storage unit. Hydrogen refueling stations of the future will probably have to be equipped with special devices to collect and use the heat gained. On the other hand, hydrogen is a storable secondary power source, which is obtained through energy expenditure, and which therefore can never be the cheapest power source.

The development of the power unit should be completed by the end of 1990. Then one can anticipate road tests, which doubtlessly will be successful. The tests will not be able to erase one question mark however. To extract hydrogen from water, electric power, which can originate in any power plant (or from a solar- or wind-power facility, is, as a rule, necessary. Unfortunately, the extraction of hydrogen is cursed with a disappointingly low efficiency factor. Each additional intermediate step before the production of drive in the automobile is subject to the aforementioned observation, so that the efficiency through all the intermediate steps is very low. Consequently, hydrogen-fueled engines can be very expensive. Opposed to this, electric automobiles store electric power directly from the beginning of the chain. The storage efficiency of batteries is about 75 percent—considerably higher than in the case of the multistep detour via hydrogen. Consequently, the same trip made by an electric automobile would be substantially cheaper than with the hydrogen automobile. One can also safely presume that the manufacture of the battery for the electric automobile, including its fuel cell battery, would also be cheaper than the power unit developed by Battelle. Batteries can be recharged over night simply through any ordinary home electrical wall socket. Since sodium-sulfur batteries offer approximately the same crusing range as the hydrogen power unit, it is difficult to see what chance hydrogen-fueled automobiles might have in the road traffic of the future.

COMPUTERS

FRG University Obtains Siemens Supercomputer

90CW0096A Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 20 Dec 89 p 8

[Article: "Siemens Supercomputer for Technical University in Aachen"]

[Text]

14 Universities Have Access to One of the World's Most Powerful Computer Centers

The RWTH [Rheinisch-Westfaelische Technische Hochschule] Technical University in Aachen is taking delivery on one of the world's most powerful supercomputers. The step-by-step installation of the Siemens S-600/20 vector computer being manufactured by Fujitsu in Japan is to begin as early as the spring of 1990. Final system expansion of the 23.5 DM system, which is capable of performing 5.3 billion floating-point operations per second (gigaflops), is targeted for the beginning of 1992. At this time, at the latest, the computer center of the RWTH in Aachen will have at its command—together with its existing IBM mainframe system—

computing capacity which in terms of power and quality will likely be the highest in the world.

The new high-performance computer will be operated as a vector computer for the State of North Rhein Westfalia, to be used jointly by all 14 colleges and universities in this West German "Land." The system is being installed in Aachen in line with the principal needs of the primary group of users. The RWTH Technical University incorporates numerous engineering institutes in the field of fluid physics, in which field extensive computing and memory capacity is almost always a necessity.

According to those who will operate the system, it is to be used only for those problems which most benefit from the system's vector architecture, while those problems for which such vector computing power is not a priority requirement will be run on the high-performance IBM 3090/600 S universal computer, installed at the RWTH at the start of 1989. Both systems will be connected independently of one another to the FDDI high-speed network of the Aachen technical university, which went into operation a short time ago.

This arrangement deviates from the customary front-end configuration in that the user communicates with the mainframe via an intermediate computer rather than directly. Dialog applications, however, are gaining in popularity in the engineering sciences. The mainframe can be used as a computing server to execute computation-intensive program sections in an extremely short period of time, returning the results to the user via his workstation computer. In this configuration, the users are granted computing time on a project-oriented rather than a generic basis.

FACTORY AUTOMATION, ROBOTICS

Production, Control System Speeds Aluminum Processing

90CW0089 Duesseldorf VDI NACHRICHTEN in German 22 Dec 89 p 16

[Text]The implementation phase is current at the moment. During the second half of 1990, start-up is anticipated: Then the aluminum rolling mill of Hoogovens in Coblenz will have a new production planning and control system, which will combine the product structure with the material flow structure. In this way, real capacity can be taken into account at each individual production stage. Upshot: The job run-through time shrinks to a minimum.

By introducing "simultaneous planning", Hoogovens Aluminum at its Coblenz plant wants to achieve a great deal at one stroke: A reduction of inventory for goods in progress, for finished goods, and for raw materials by about 30 percent, a reduction of rejects, and an increase of yield. Simultaneous planning, that is an integrated planning of quantities, deadlines, and capacities, in addition should contribute to increased transparency for factors that cannot be quantified or can be quantified only with difficulty.

"Short run-through times and high fidelity to deadlines - and this with lower inventories - in the future will be even more important to secure the competitiveness of our business," says Dr. Arnold Keller, EDP manager at Hoogovens. For this reason, a new production planning and control system is supposed to be important.

In Coblenz, roll ingots related to customer orders, and composed of the most various aluminum alloys, are processed into plate and strip material of various dimensions (about 9500 tons per month). The ingots come either from the casting foundry that precedes the rolling mill or are manufactured externally, e.g. in another casting foundry belonging to the group.

"Analysis of the current state showed that optimization of the present planning and control system cannot achieve the desired improvements," says Dipl. Eng. Ute Mussbach-Winter of the Stuttgart Fraunhofer Institute IPA, who collaborated in developing the project.

Jobs are now formed by taking into account the capacity situation of each individual production stage; the secondary demand is derived from the production jobs of the respectively supervening process stage. "This mode of procedure fulfills an important precondition for achieving short run-through times, namely exact coordination between supply and consumption," argues the PA-expert. Product structure (parts lists and capacity- or material-flow structure working plans) would be fused into one planning structure coordinated according to disposition and capacity perspectives.

Planning here runs counter to the material flow direction: Starting from the last process stage, shift programs are formed step by step up to the raw material and purchasing level for all elements of the planning structure.

The initial information is the primary need as specified by quantity and deadline. This is covered by the inventory available at the moment of planning. The resultant net need triggers the formation of a job.

Process-specific boundary conditions are taken into account.

Something that makes the Coblenz Hoogovens man Keller especially happy: The formation of jobs takes into account the capacity supply for each planning time segment as well as the set-up criteria, tool lifetime, product quality, etc. in the Coblenz plant, with inclusion of the process-specific boundary conditions. The transfer times between two process stages are generally neglected, unless process-based factors require defined waiting times, as is the case, e.g. with cooling.

However, to prevent minor disturbances at one process stage from affecting the next process stage, and to secure

a disposition margin to the shop control, only one working cycle (process stage) of a job is planned per shift.

The formation of jobs with inclusion of capacity requires that all the items to be processed (demand) are known for a capacity group at the time of planning. According to IPA staff member Mussbach-Winter, this requirement can be fulfilled without any problem if no material flow loops exist in a production run. Material flow loops always exist when one and the same material flow object must be processed several times on the same capacity unit.

With integrated quantity-, deadline-, and capacity-planning, this causes the demand from subordinate process stages to exist only when jobs have been formed for process stages lying between the loop. Consequently, special solution formulations were developed to treat material flow loops.

"The daily plan is set up in a preliminary session at night," explains Dr. Keller. The result is shift programs with a horizon of about 8 to 12 weeks for each capacity unit (production facility). These shift programs are the prescription for the shop control.

It is possible to modify the job sequences unless sequence-dependent set-up costs occur at the respective capacity unit, or sequence- dependent quality changes are to be expected. The production deadlines of the jobs at the individual process stages are binding, however, since non-adherence to them jeopardizes the deadlines of all subsequent process stages.

Dr. Arnold Keller, the project manager at Hoogovens, and Ute Mussbach- Winter of the Institute for Product Engineering and Automation (IPA) in Stuttgart are certain that the system functions. Due to the close coordination of material supply and consumption, the quality of the planning result depends especially strongly on the quality of the input information and thus especially on process status data. For this reason, a sharp control and operations sensing system must be introduced as a precondition, as it were, for the production planning system.

Austria: Plastics Processing Firms Adopt CIM

90CW0096C Duesseldorf VDI NACHRICHTEN in German 15 Dec 89 p 29

[Article by Peter Kudlicza: "Austria's Plastics Industry Turns to Automation; Production Needs Proof of Quality; Pressure of Investment Forces Industry into Process of Concentration"]

[Text] Statistics indicate that around 14% of Austria's plastics processing plants operate with no permanent staff, and can be considered "one-man shows," if one disregards family members who help out in the businesses. A third of all companies have at most four employees, and in only about 2% of companies are more than 100 names on the payroll. According to industry insiders, this structure has not changed much in many years. As quality requirements grow, these companies are now starting to crumble; evidence of concentration is already apparent.

Small-scale plastics injection-molding businesses are not just miniaturized large companies whose facilities are often located in cellars; the structures of the two types of companies are hardly comparable: Small operations have individual machines for the manufacture of individual parts, while large companies use production lines for the manufacture of assemblies. In small companies, the comprehensive skills of universally talented individuals are utilized, while industrial concerns turn to specialists. The small-time operator brings his experience to the development process, while large companies utilize the services of an R&D team.

Both structures offer flexibility, although in different ways: The small business achieves its goal through the use of personnel, while industrial companies turn to automation.

Quality Control Migrates from Customer to Supplier

Only a few companies in our neighbor country manufacture finished products. Most of them operate as suppliers to industry, whereby the automotive industry is a driving force—as it is in the plastics industry throughout Central Europe—which generates a "significant dependency relationship," as stated by Reinhard Bauer, head of planning for Engel, the foremost Austrian machinery manufacturer.

The interwoven nature of this relationship requires that special measures be taken in order to keep the industry running smoothly. Logistic concepts whose objective is to have the right parts at the right place at the right time are becoming more and more important; the wave of changes in manufacturing companies brought about by the introduction of a computer-integrated manufacturing system is also having an effect on suppliers.

The customer's objective of reducing stocks on hand requires "just-in-time" delivery by the supplier—a concept which is still foreign to many of Austria's plastics companies. The step-by-step reduction of manufacturing depth and the contracting-out of portions of the scope of production to suppliers is occurring together with a shift in the quality control aspect of manufacture from the orderer to the supplier.

Here, quality is emphasized, although it can be documented in only a small number of cases: Only in roughly 5 to 10% of all companies is quality controlled "on line," according to Georg Tinschert of the marketing department at Engel. "The plastics company must no longer simply produce quality, but must document it as well."

Machinery manufacturers offer modern manufacturing supervision and control systems for quality control purposes, as well as for quality documentation and statistics. But these systems require major expenditures. As a rule

of thumb, Bauer says that the cost of acquisition of a plastics injection molding machine increases by roughly 30 to 50% with the implementation of a quality assurance system with automatic scrap ejection, and that upgrading a system to a completely automated configuration requires double the investment.

Entry into the industry at the current level of technology, however, is less a question of desire than financial ability. The rule which says that manufacturing systems pay their way through higher-quality products is just as cut and dried as the fact that these systems require the appropriate investment. Expensive "complete packages," however, are essentially beyond the reach of small businesses.

Intermediate Stops Along the Way Toward the CIM Factory

The consequences are already apparent: Bauer, who sees the stiff company structure as an "alarm signal," anticipates "enormous concentration" in the case of Austria's plastics processing companies—the big companies will get bigger. He feels that a structure like the present one may indeed be viable again in perhaps fifty years—but only if manufacturing facilities are fully-automated.

In order to smooth the path along the way, the equipment manufacturer in the north of Austria—which exports roughly 92% of its products—is turning toward the gradual introduction of automated equipment, beginning with a minimum configuration and expanding into a fully CIM-oriented factory in a series of partial and intermediate steps. Slow expansion rather than huge expenditures is necessary, because the existing level of production must be maintained.

"These partial steps," says Bauer, "must fit smoothly into a previously established overall plan" which is supported by the experience gained in the use of manufacturing islands. Basic machines were upgraded—through the addition of automation modules such as manipulating devices, and pallet transfer and material conveyor equipment—to form systems with sophisticated controls.

Once these entry-level hurdles have been overcome, the prognosis for Austrian plastics processing plants is indeed optimistic—"not in the plastic dishes market, because those products come from Taiwan," but in the manufacture of high-quality products.

For this reason, Bauer also sees the expected downturn in the packaging industry without alarm. He is of the opinion that the increased use of plastics in the manufacture of technical components and precision products—accuracies in the range of a few microns are already being achieved in a joint research venture with the Montan University in Leoben—will compensate for losses in the commodities and disposable-product markets in terms of product value, if not tonnage produced.

The requirements of precise planning and a thorough quality assurance system with constant monitoring of the manufacturing process in the plastics processing industry are met by the development of a software system for monitoring and control of the injection molding process. This system, marketed under the name "Engel NET," is also modular in design; its functions can be adapted to the needs—and finances—of the user.

Existing injection molding machines need not even be microprocessor-controlled: The system can even be connected to machines made by other manufacturers—although the scope of available functions will be limited—via a special interface or a BDE terminal.

All essential operating information is recorded and documented; job information can be transferred to the system from other computers, and the system can report further developments in the production status back to other computers. In addition to remote diagnosis in the event of a malfunction, the maintenance interface offers remote monitoring capability, so that manufacturing equipment can continue to run without operator attendance over a weekend, for example.

The Pollmann company in southern Austria is one example of an Austrian plastics processing company which uses advanced production processes and quality assurance systems. Pollmann manufactures some 40,000 chassis for video recorders per week as a supplier for Philips. The sheet metal chassis has a number of widely differing recesses and cutouts. An injection molding machine inserts roughly 80 precision plastic parts such as gear racks, shafts, bushings and levers into the chassis on both sides.

After they are manufactured, the parts are inspected for any quality defects. Each chassis must be manipulated for part insertion and inspected in 36 seconds. Such a rapid processing rate suggested replacement of the visual inspection process with an automated one. A computer-controlled inspection apparatus with automatic image detection was developed for this purpose.

Computer Uses Video Cameras to Detect Defects

Chassis in groups of two with plastic parts inserted are looked at by three video cameras: from below, from above, and by transmitted light. The operation of the inspection device was synchronized with the cycling rate of the injection molding machine.

The computer compares the digitized images to a reference image. If the two images are not identical, both a visual and an acoustic alarm indicate that the chassis is defective.

Using a supplementary program which logs the defects, it is possible to perform a statistical analysis of repetitive defects and eliminate those which are traceable to a problem with the injection molding machine. The video recorder manufacturer can be given documented evidence of the quality of the manufactured parts.

LASERS, SENSORS, OPTICS

Aerospatiale's Laser Activities Described

90cw0111 Paris ELECTRONIQUE INDUSTRIELLE in French 12 Dec 89 pp 49-52

[Article by Gilbert Rhemes: "Comeback of Power Lasers"]

[Text] After three lackluster years, power lasers are making a comeback with the revival of industrial investments. CO_2 lasers, like YAG [yttrium-aluminum garnet] lasers of over 1 kW, are being installed in factory workshops. To weld, cut and treat surfaces. But in this sector, in which France was once looked on as a pioneer, we have serious weaknesses which must be corrected quickly; otherwise, we may be excluded from a market dominated by the German and the Japanese.

The Unilaser holding, fully owned by Aerospatiale, was created at the end of July 1989. Unilaser itself fully controls the following:

—Quantel, a company based in Les Ulis near Paris; it develops and produces lasers for scientific applications and designs solid-state lasers for industrial applications.

—Laserdot, based in Marcoussis; it specializes in studies and research on high-energy lasers and civil or military systems using laser beams.

Laserdot was created on 1 October 1989. Its announcement followed that of 12 June 1989 when, right in the middle of the Le Bourget Air Show, we learned that CGE [General Electricity Company] was selling to Aerospatiale the optronic activities of the Marcoussis Laboratories (the CGE Research Center) and the shares of Cilas Alcatel which had been held by Alcatel NV (a CGE subsidiary); today, therefore, Aerospatiale owns 40 percent of the stock of Cilas [Industrial Laser Company], a company headquartered in Marcoussis and with a plant in Orleans; the CEA [Atomic Energy Commission] and the Sagem group [Company for General Applications of Electricity and Mechanics] each own 20 percent of the Cilas stock. CGE thus divested itself entirely of all laser activities.

As for Quantel, it belonged in part to Sfena [French Company for Air Navigation Equipment] which sold its shares to Aerospatiale when it became Crouzet's partner in the Sextant project.

Finally, jointly with the CEA, Aerospatiale created Lisa [Industrial Lasers Company], a company specialized in lasers for industrial applications.

Civil and Military Lasers

The French power-laser industry has thus been entirely restructured. Aerospatiale owns four poles: Laserdot (110 employees) with sales of about Fr75 million; Lisa (15 employees) which is just starting its operations; Quantel (90 employees, about Fr50 million); and Cilas (240 employees; about Fr220 million).

The thorough reorganization which took place in 1989 may also well have repercussions in coming months, with more mergers, buyouts or stock purchases.

We may wonder if small French laser companies still have a chance to live in isolation when there are already so many of them (BM Industries, Laser Application, Micro-Controle, Adron Sources, Mecachrome, etc.) and when the German and Japanese are exerting so much pressure. Especially now that these companies can no longer count on support from the machine-tool sector.

For the time being, the strategy of large groups such as Renault, Air Liquide, CEA Industrie, etc., does not include any forceful intervention on the industrial-laser market, due to the lack of success of some of their previous initiatives. But this does not mean that they will not enter this market again. Besides, how could Renault or Peugeot SA really lose all interest in power lasers when, in Japan, Toyota is already using seven YAG power lasers from NEC? The main CO_2 power-laser suppliers are Rofin Sinar (with about 25 percent of the market) which was bought by Siemens 2 years ago, but also Trumpf, Mitsubishi and Coherent.

Besides, the world YAG-laser market is undergoing profound changes: Rofin Sinar is entering it with considerable resources while, last March, Sumitomo Heavy Industries, one of the most powerful Japanese industrial conglomerates, launched a friendly takeover bid on the Canadian Lumonics Inc., which for a long time was the world leader for YAG lasers.

In Japan, the annual growth rate of the industrial laser market is 29 percent; 33 percent for the YAG-laser systems market, which is dominated by NEC (60 percent of microelectronic applications), followed by Toshiba (30 percent). In the CO_2-laser subsector, over 50 Japanese suppliers have been identified; they are headed by Mitsubishi Electric (30 percent of the market), Amada (17 percent) and Shibuya Kogyo (13 percent); considering the large number of suppliers, the price of laser systems are expected to drop by 35-40 percent by 1993.

"The underlying motive of Aerospatiale is the development of weapon systems based on intermediate- and high-energy lasers," explained Alain Guigue, the Unilaser CEO [chief executive officer]. But there is synergism between military and civil laser: "Laser-matter interaction studies and studies concerning applications in weapon production are in perfect symbiosis with civil-laser computer-integrated manufacturing activities," Alain Quenzer, general secretary of the Power Laser Club wrote last year in a paper on the situation of laser in France.

This Club is a learned society which counts 160 members; one of its main purposes is to federate all the players in the field: for this, it organizes annual meetings, such as Europa Laser, a national symposium on power

laser which was sponsored by the Burgundy technopole and held at Le Creusot on 18-20 October 1989. Working groups are active and training programs have been launched.

"After a period of strong growth of the world markets for industrial lasers, the deterioration of the overall economic context coupled with keen competition putting pressure on unit prices, led to a marked decline of the sales growth rate in 1986," A. Quenzer explained.

In addition, "the industrial positions of laser-source manufacturers are definitely shaky, a characteristic of sectors which use recent and fast-progressing technology." For instance, Avco Everett, once the leader in high-power (up to 25 kW) CO_2 lasers, declined as its technology aged: it was bought by Combustion Engineering in the mid-1980's, and its laser activities taken over by Trumpf in 1988. The same thing happened to Spectra-Physics, taken over by Siemens at the beginning of 1988, and to Photon Source, taken over by Lumonics. "In Europe, CBL and Cilas, which had ranked first, declined whereas, with a similar technology but a more industrial product, Rofin Sinar became the leader on the world market and now benefits from Siemens's financial support."

As a result, in Europe, German manufacturers have acquired a strong position in CO_2-lasers, with Siemens and Trumpf implementing a strategy of growth through absorption of other companies, especially in the United States which have lost their position of dominance.

The group formed by Aerospatiale will benefit from the recovery of the laser sector in industrial applications, a recovery related to the revival of investments, in particular in the automobile sector (at Mercedes-Benz, catalytic converters are welded by laser), in the aeronautical sector (to mark the Airbus cables, to cut sheetmetal), in telecommunications (to weld the metal conduits of cables). Subcontractors will also come (back) to lasers.

In his report, Alain Quenzer contemplated the creation of the horizontal integrating structure which was adopted and added that "such a solution could be the first step for a major company to take over the laser sector." Which company, then?

Toward Weapon Systems

"Laserdot is very much geared to weapon-system lasers," Alain Guigue, the Unilaser CEO, pointed out: "It is working on the Latex project which involves the definition of an experimental 40-kW CO_2 laser." The project involves in particular research on a very fine aiming system using adaptive optical systems (to correct atmospheric turbulence), and on the transportation of the high-energy beam by telescope. The short-term objective of Latex is the capability of destroying optical systems (those which guide a fast-moving designated target: in other words, a missile); its longer-range objective is the destruction of metallic structures.

In Marcoussis, Laserdot has manufactured most of the Latex project components: the intermediate-energy laser, cooled optical systems to support the laser flux, adaptive optical systems, the three-axis vernier mirror incorporated into the telescope for fine aiming, the fire control system using a VME [Motorola] bus. This experimental laser will be installed and perfected at the Landes Testing Center by 1991. For after 1992, we can expect the construction of a high-energy laser, if possible as a joint French-German project, followed by an operating stage, etc.

Laserdot's other activities include research on laser sources (on behalf of Cilas): solid-state diode-pumped lasers (for telemeters, illumination systems), tunable solid-state lasers, chemical lasers, high-safety sources (the human eye is sensitive to wavelengths of about 1 micron). As part of the Eurolaser (industrial lasers in Eureka) EU-205 (high-power excimer lasers) program, Laserdot is studying pulsed excimer lasers with a power of about 1 kW, producing a high-frequency (100-500 Hz) low-energy ultraviolet beam; as part of the same program, Sopra (a small to mid-size French company which has been the only French excimer-laser manufacturer since 1982) is dealing with low-frequency (10 Hz or so) high-energy lasers.

Last year, CGE gave up manufacturing civil lasers and refocused its Cilas operation on the military and nuclear sectors. As a result, Cilas sold part of its research activities to IMT (Mediterranean Technology Institute, Marseilles), in particular its activity in the Eureka EU-194 program (evaluation of the industrial applications of high-power (5-10 kW) CO_2 lasers). Within Aerospatiale, Cilas is pursuing its research along these new lines of military lasers (telemeters, illumination systems) and copper-vapor lasers for isotope separation.

Highly Competitive Industrial Sector

Quantel, for its part, is renowned for its scientific activities: locked-mode YAG lasers for instruments, tunable colorant lasers, femtosecond lasers, etc. It coordinates the Eureka EU-226 program aimed at developing high-power pulsed (1-1000 Hz) YAG lasers: 1.2 kW to start with (prototype delivered to the CEA for validation and evaluation), with a contemplated extension around 3.5 or even 5 kW. Another small company, BM Industries, is co-contractor for this program.

This program is targeting a market in which Germany alone accounts for one-half of the European market. The German potential market for this type of lasers is expected to exceed 2,300 units over the next 10-15 years: 44 percent in the 1-2-kW range, 35 percent from 2 to 3.5 kW, and 21 percent from 3.5 to 5 kW.

Note also that there is no French participant in the Eureka EU-83 program which aims to manufacture a 25-kW CO_2 laser, although it includes 11 British, German, Spanish and Danish university and industrial organizations.

Lisa (Industrial Lasers Company) is the most recent member of the group: it was created to produce and sell lasers for the industrial sector, essentially integrated-turbine CO_2 lasers with powers of 800 W (2M laser; M is for modular), 1000 W (3M laser) and 1500 W (4M laser), using the compressed-flux technique developed by Dr Held and the Battelle Institute. The first orders received were from a welding company in France, and for laser-machining equipment in Sweden and Germany. For the time being, these lasers are manufactured in Frankfurt, Germany, by the Laser Technique factory which belongs to Lisa. This month, December, a second factory will start operating in Nevers; it should reach its full production rate in the next two months. The production capacity of the French company will then be 25-30 lasers per year. Similarly, Lisa is expected to set up very soon its worldwide laser distribution network.

The second development stage starts this December, with the assembly of the prototype of a 5-kW industrial laser. Its development and adjustment should take from 9 months to 1 year.

Regional Laser Poles

Various national and regional centers were created already in 1980 to ensure the transfer of power-laser technology to the industrial fabric:

—ETCA [Central Technical Establishment for Armament], with a multistation laboratory and three CO_2 lasers: 1, 5 and 25 kW;

—CEA with two CO_2-lasers (3 and 5 kW) and one 400-W YAG laser.

In the regions, IREPA (Strasbourg), Calfetmat (Lyon), LET (University of Brittany), Calfa (Bethunes), the Le Creusot IUT [University Technology Institute], Bourgogne Technologie, IMT (Marseilles), as well as the ENSAM [National Advanced School for Industrial Arts], Ecole Centrale [National School of Engineering] and the Welding Institute are using 1-kW to 10-kW CO_2 lasers, YAG lasers (300 or 400 W) and excimer lasers. Burgundy specializes in power lasers. However, according to A. Quenzer, "the drawback of this good regional distribution of facilities is that the teams are smaller, compared for instance with those of the ILT (100 researchers in Aachen)... Contrary to Japan, the United States and the FRG, France lacks technological laboratories to promote laser-related technologies."

Faced with this fact, reckless manufacturers continue to invest in industrial laser: some 300-350 lasers with a power in excess of 400 W are operated in France.

These lasers are not bought just by large organizations: the LTTA (Laser Technologies and Applied Techniques) headed by Guy Aubertel is a small to mid-size company of 4 people (sales: Fr2.7 million) created in July 1986 to intensify metal-forming and automotive activities; it uses a 5-axis Trumatic L-5000 laser robot from Trumpf (the power of which can be adjusted between 50 and 100 W) connected to a 3D surface computer-aided manufacturing system running on GNC software from the British CadCenter; the unit is used essentially for 3D cutting of skewed parts, prototype sheetmetal parts, small series (e.g. feasibility study of the cutting of car-door panels). The laser unit can work at any angle imposed by the part configuration.

Framatome has just purchased a continuous 1.2-kW YAG laser from NEC (via Actilaser); it is one of the two most powerful lasers in Europe, and the most powerful in France. It is installed at the Framatome Welding Center in Le Creusot, where it performs highly specific maintenance operations on the stem generators of nuclear boilers. An identical YAG laser is installed at the Le Creusot IUT.

YAG power-laser beams can be transported through optical fibers (600 microns in diameter) with very good results (transmission rates above 87 percent over 50 m), and with a nearly Gaussian energy distribution at the output, thanks to the use of graded index fibers. It is then possible to have almost the same working conditions as those obtained with continuous CO_2 lasers. In other words, it works just as fast, it probably uses less power because the YAG laser beam (wavelength: 1.06 microns) is absorbed better in metal, and the power concentration after the multiple-lens (up to 8 lenses) focusing system is enhanced by the graded index optical fiber.

When associated with robots or beam-multiplexing systems to supply several machining stations, these fibers can be equipped with a safety device which interacts with the laser generator if the optical cable is broken.

NEC has announced a new and more powerful version of the YAG laser: the model YL 117-6C will deliver up to 2 kW in the continuous mode.

MICROELECTRONICS

French Firm Applies Automated Surface Mounting Technique

90CW0108B Paris ELECTRONIQUE ACTUALITES in French 7 Dec 89 p 24

[Article by G. Cuciuc: "CMS Electronique: Priority to Automation"]

[Text] Aix-en-Provence. In order to provide its customers with the most advanced technologies (particularly CMS [surface-mounted components]) so as to reduce costs and space requirements, and to improve quality and reliability, the Aix-en-Provence (Milles ZI [industrial zone]) subcontractor CMS Electronique (68 employees, 43 million francs in revenues) continues to improve the robotization and flexibility of its production facilities.

A second phase of automation is underway following the installation of seven equipment areas. It represents an

investment of more than 2 million francs. A third phase planned for the 1991/92 fiscal year will fully automate the inter-area operations.

Transfers among the areas will be carried out by computer controlled independent systems (wire-guided carriers or other methods). This will represent one more investment of over 2 million francs. This functional organization is intended to minimize failure risks (immediate manual override of process control) and to best manage quality assurance in development and production, as well as test reliability.

Starting with files or functional prototypes supplied by customers, this company, devoted primarily to CMS technology, develops products, generates the documents required for production, test, and control operations, and rapidly integrates all modifications. Its facilities include CAD/CAM (Computervision) equipment that is very well adapted to the design of printed circuits.

Automatic Inspection With CCD Camera

This equipment provides circuit drawings, logic simulation, automatic placement and assembly, and so on; it also manages program files for production machines, and for photoengraving magnetic tapes. For the production of boards, the areas are equipped with Philips MCM1 and Siemens HS 180 machines for CMS component phototransfers, and with Amistar machines for inserting conventional components.

The company uses vapor-phase and double-wave soldering systems, allowing it to attach all types of components on conventional, CMS, and mixed (conventional components and surface-mounted) cards.

For inspection, in addition to such traditional instruments as microscopes, CMS Electronique is equipped with an Axys Vision automatic system for inspecting cards after soldering (first company of its type to use this equipment). A CCD camera in conjunction with a computer automatically verifies the aspect of joints, and the presence and placement of both conventional and CMS components.

A Factron Schlumberger Series 730 tester and functional test benches complete the inspection facilities.

CMS Electronique can also debug products under power, statically or dynamically, with negative and positive temperature cycling, as well as assure their assembly. Following acceptance, they can be shipped directly to the customer's distribution network.

48 Million Francs Revenues in 1990

The revenues of CMS Electronique, which was created on 1 August 1986 after Datel's bankruptcy filing, have risen from 16 million francs in its first fiscal year, to 34 million francs in the second and 43 million francs for this year's. This represents a production of approximately 200,000 boards, 65 percent of them in CMS and mixed technologies. The 1990 forecast is of the order of 48 million francs, 10 percent of which will be from exports.

ADVANCED MATERIALS

Test Results Using GDR's HU 515 Multipurpose Metal Reported

90CW0065 Berlin FERTIGUNGSTECHNIK UND BETRIEB in German No 11, Nov 89 pp 664-666

[Article by K.-H. Soeder, KDT, VEB Research, Development and Efficiency Studies of the SAB Magdeburg, Combine Operation of the VEB SKET: "Machining Tests With the Multipurpose Metal Type HU 515"]

[Text] **Introduction**

The multicoated, multipurpose hard metal type HU 515 (ISO machining application groups P10 to P30, K10 to K20) which was developed in the VEB Hard Metal Plant Immelborn consists of a special three-phase substrate hard metal with a composite carbide phase rich in tantalum which results in high flexural and heat resistance.

The coating process consisting of a Ti(CN) multilayer supplemented by a modified aluminum oxide cover layer follows the CVD principle.

The coating system consists of 10 to 12 individual layers with thicknesses ranging from 0.1 to 1 µm.

The cutting material HU 515 has a rounded cutting edge radius of 0.02 to 0.03 mm. Therefore advance rates of s less than 0.10 mm should be avoided. According to the manufacturer, a radius to advance ratio of greater than or equal to 2:1 should preferably be used to avoid shortening tool life and to ensure a normal machining process.[1,2]

The VEB Research, Development and Efficiency Studies of the SAB Magdeburg (VEB FER) conducted tool life studies using this new cutting material. Selected representative samples of the 11 material groups of the SWS were used.

1. Test Conditions

The test conditions (Table 1) applied to all tests conducted. To obtain a chip shape class 4 to 6, the indexed inserts to be used were assigned to the individual test programs based on available empirical values.

Table 1. Test Conditions

Machine tool	DF2/2-CNC 600	
Driving power	25 kW	
Speed control: continuous		
Advance control: continuous		
Materials tested	SWS material group	Material code
	1	St 42b-2
	2	C45N
	3	St 70-2
	4	42MnV7G
	5	36CrNiMo4V
	6	42CrMo4V
	7	30CrMoV9V
	8	Gs-50
	9	Gs-30CrMo4N
	10	GGL-20
	11	GGG-6002
Sample dimensions	Diameter 200 mm x 700 mm long	
Tool	Clamp CL 71 2525	
Indexed inserts	SNUG 150404-316	
	SNUG 150408-325	
	SNUM 150408-332	
	SNUM 150412-340	
Cutting material	HU 515	
Cooling	None	
Test site	Test Center SWS	

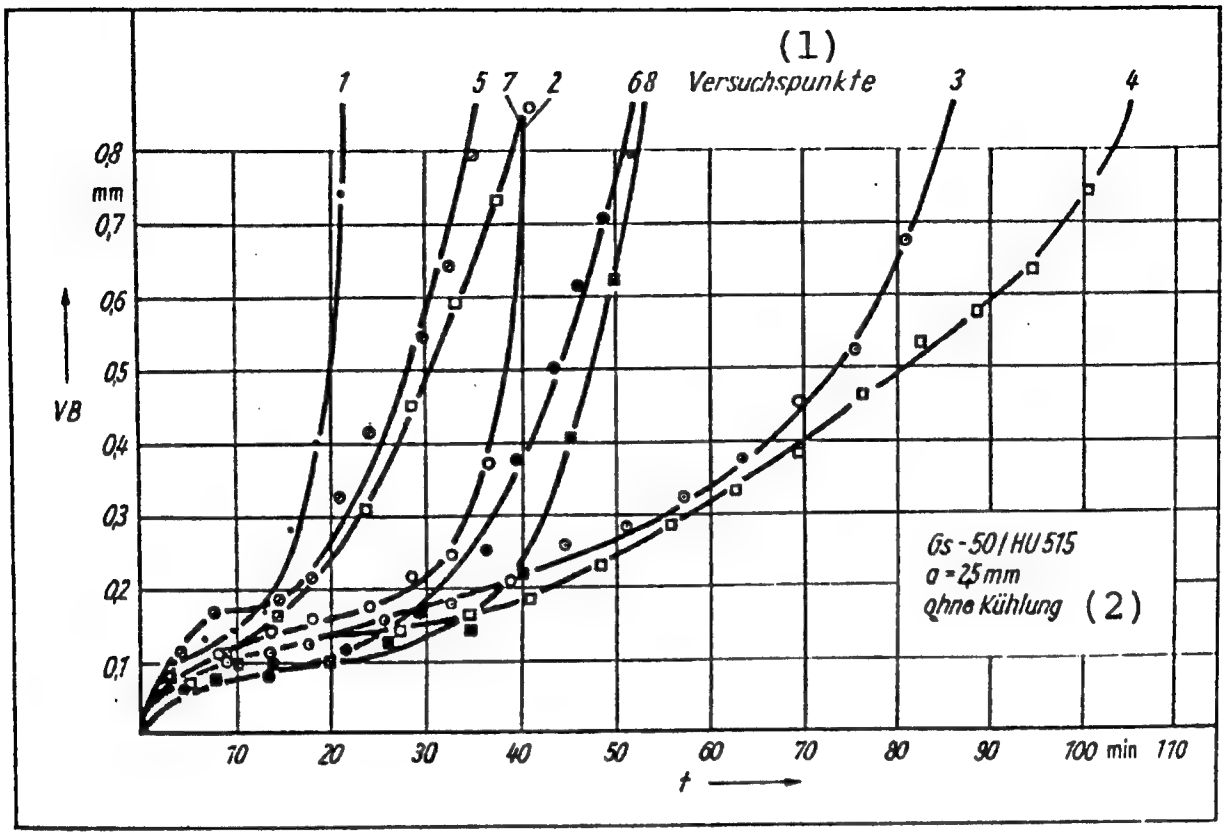

Figure 1. Flank Wear With Test Program Gs-50/HU 515

Key:—1. 68 test points—2. No cooling

2. Wear Tests

The tests were carried out based on the "Regulation Concerning the Planning, Implementation and Evaluation of Experimental Tests To Determine Machining Characteristics for the Cutting Speed Register (SWS)."[3]

One representative sample for each SWS material group was included in the tests.

To minimize the use of material and time, a constant cutting depth of a equals 2.5 mm was maintained for all tests, and the effect of the cutting depth on tool life was taken into consideration by incorporating empirical values obtained over many years into the tool life functions which we determined.

The tool life functions developed from the test results obtained T equals A5 v_{A2} s_{A4} a_{A6} for roughing and finishing were included in the files on material/cutting material of the program "Wear and Performance-Related Cutting Values—Turning" and the SWS process program for turning. They are available to interested parties.

3. Test Implementation

The test series "Gs-50" (SWS material group 8) illustrates the basic setup of a test plan according to ref. 3. The cutting speeds of the individual points of a test plan were selected so that the tool life was between T = 30 to 60 min in most cases.

3.1 Test Program

Figure 1 shows a graphic representation of the wear cycle in form of a manual evaluation of the test results according to Table 2.

3.2 Test Results

The test results (Table 2) show that: the individual test points did not display any special features in the form of outliers; with this material, the advance rates have a considerable effect on tool life compared to results obtained with uncoated cutting materials; and the tool life variation in the repeat tests performed under constant conditions is approximately 50 percent for an acceptable wear of cutting edge value VB = 0.8 mm (see test points 5 to 8).

The tool life functions determined for roughing (acceptable VB = 0.8 mm) and for finishing (acceptable VB = 0.4 mm) are shown in Figures 2 and 3 and compared to cutting material HS 123.

When it comes to rough turning, cutting material HU 515 is much better than cutting material HS 123

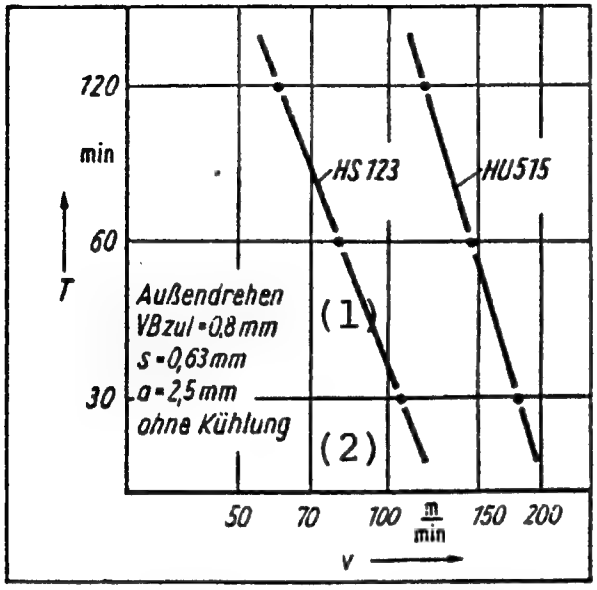

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Figure 2. Tool Life Straight Line for Roughing Gs-50
Key:—1. Outside turn, acceptable VB = 0.8 mm—2. No cooling

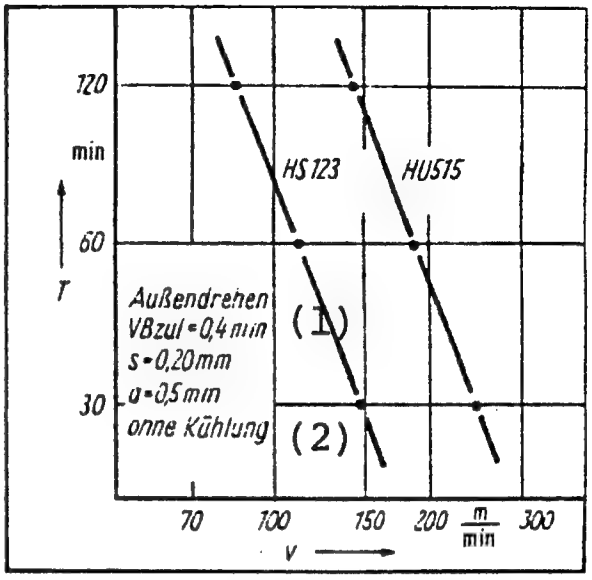

Figure 3. Tool Life Straight Line for Finishing Gs-50
Key:—1. Outside turn, acceptable VB = 0.4 mm—2. No cooling

Table 2. Test Program and Test Results for Material Gs-50

Test No.	Machining step width, mm	Cutting speed, m/min	Advance rate, mm	Tool life in min	
				Acceptable wear of cutting edge (VB_{zul}) VB_{zul} = 0.8 mm	VB_{zul} = 0.4 mm
1	3.2	185	0.50	21.7	18.7
2	3.2	170	0.50	40.7	36.7
3	2.5	230	0.25	85.0	67.5
4	2.5	200	0.25	103.6	70.0
5	2.5	200	0.375	35.0	25.6
6	2.5	200	0.375	51.3	41.4
7	2.5	200	0.375	39.4	27.58
	2.5	200	0.375	52.7	45.6

allowing cutting speed increases between approximately 70 percent (T = 30 min) and approximately 95 percent (T = 120 min) with an advance rate s = 0.63 mm. At lower advance rates, these rates of increase are slightly higher.

Cutting material HU 515 is also markedly superior with regard to finish turning. Since both tool life straight lines are almost parallel, we can establish a cutting speed increase of approximately 65 percent with an advance rate s = 0.20.

4. Summary of Test Results

We were able to demonstrate that most of the other representative samples showed the same high performance described here for cutting material HU 515.

Since a comprehensive comparison between the test results obtained and cutting material HU 510 (tool life functions in SWS are only available for four material groups), we compared them with the results for cutting material HS 123 (or material group 10:HG 110) which are available.

For roughing with an advance rate s = 0.32 to 0.63 mm, cutting material HU 515 can be recommended for material groups:

1—Structural and hardened steel types with a tensile strength R_m = 340 to 580 MPa; 3—structural and hardened steel types with a tensile strength R_m = 550 to 900 MPa; 6/7—higher alloy steel, tempered; 8/9—unalloyed/alloyed cast steel and 10—gray cast steel.

The most favorable results can be expected for material groups 7 to 9, which indicates a higher resistance of this cutting material to forging crusts, sand inclusion, etc., and to high-strength, higher alloy steels (tempered).

The same is true for finishing operations with an advance rate s = 0.10 to 0.25 mm, however, in this case the advantages of HU 515 only apply to material groups 6 to 10, with the most favorable results again in material groups 7 to 9.

Since the test results did not show any substantial differences in tool life for the material groups not listed here, the new cutting material does not seem to offer any advantages for roughing and finishing operations with these materials.

To be able to comment on the possible average rates of increase of the cutting speed when using cutting material HU 515, we attempted to establish an average value by estimating the frequency distribution of the 11 SWS material groups in the metal working industry of the GDR. The result[4] shows that an increase in cutting speeds of: δv approximately 28 percent for rough turning, δv approximately 14 percent for finish turning—can be obtained compared to cutting material HS 123 (HG 110). These results were confirmed, for instance, by parallel tests in the VEB SKET Magdeburg (main plant) for finish turning and by industrial tests with the new cutting material. The tool life variation range of approximately 50 percent is an average value from all test series conducted. In contrast to uncoated cutting materials, all tests showed considerable corner wear which had a marked effect on the life of the indexed insert and which is a wear criterion that should not be neglected. While the flank wear was between VB = 0.3 to 0.5 mm depending on the material, corner wear became so strong as to make continuing the test series impracticable.

Based on these findings, we made a compromise and used an average flank wear as a criterion of wear and gave corner wear more weight when evaluating the test results.

Another typical feature noted was the fact that tool life decreased rapidly once the multilayer had rubbed off, as indicated by a very progressive wear curve (at times with an abrupt rise).

5. Cutting Speed Recommendations

The cutting speed recommendations based on the tool life functions determined for cutting material HU 515 for a tool life T = 30 min are shown in Table 3.

Table 3. Cutting Speeds v_{30} in m/min for Cutting Material HU 515 as a Function of the Material Group

SWS material group	Cutting speed v in m/min with an advance rate s in mm					
	Roughing (a = 5.0 mm)			Finishing (a = 0.5 mm)		
	0.32	0.50	0.80	0.10	0.16	0.25
1	244	239	234	249	247	244
2	159	133	110	260	223	193
3	175	168	160	195	187	180
4	151	148	144	170	166	162
5	165	148	132	210	193	179
6	178	157	138	237	213	192
7	163	156	149	185	181	179
8	229	185	148	334	273	225
9	190	177	164	231	215	200
10	96	82	69	155	129	109
11	110	101	92	128	120	114

The VEB FER is offering a catalog "Recommended Machining Values—Turning With HU 515" to be used by interested parties.

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Investigating Applications for Conductive High Polymers

90CW0076A East Berlin Radio Fernsehen Elektronik in German No 11, Nov 89 pp 705-706

[Article by Peter Iancu, Ingrid Pittl, et al.]

[Text]**Bulletin from the Electric Energy Systems Section of the Leipzig Institute of Technology.**

The importance of conductive high polymers in replacing conventional materials is constantly increasing. This paper publishes investigations and their results in this area performed at the Leipzig Institute of Technology.

Developments in the areas of automation technology and scientific equipment construction require new, unconventional materials. In this area, polymeric materials are receiving attention with the intention being to combine properties specific to polymers such as low density, small production costs, good workability, and resistance against corrosive effects with good electrical conductivity and mechanical stability. At this time primarily filled polymers containing conductive additives such as carbon black, metallic particles of copper, iron, silver and nickel or graphite thereby achieving pseudo-conductivity, are being used in practice [1] [2]. Another possibility for obtaining polymers with electrical conductivity consists of intervening directly in their molecular structure [1] [2] [3].

This article presents an overview of current research at the Leipzig Institute of Technology in the area of conducting polytetrathiafulvalenes and polybisorganylthioacetylenes that can be modified into conductive polymers using laser radiation. The state of materials development at the Merseburg Institute of Technology is used as a starting point.

Sample material and laser irradiation

The standard new polymer formulation for solutions used to produce coatings that can be modified with laser beams consist of mass proportions of 7.5% polybisethylthioacetylene (poly) and 4% nickel-(0)-complex (the percent sign here is referenced to a weighed potion of polymer). The constituent elements are easily soluble in CHCL3 and can be deposited onto the substrate material using the horizontal centrifuging process. Polyimide foil proved useful as the substrate material with the nickel-(0)-complex increasing the conductivity and the adhesion of the photopyroconverted layer. The thickness of the polymer layer is 7 um. A laser beam induces photopyroconversion of the polymers using the laser-beam exposure unit shown in [5]. In the investigation using laser irradiation, it was shown that a defined threshold of irradiation intensity is necessary to produce the conducting structures [6]. An irradiation density of 3.8 x $10^3 Wcm^{-2}$ is sufficient if the scan rate is 2 ms^{-1}. An electrical conductivity of 100 Scm^{-1} can be achieved in this manner. An irradiation density of 1.2 x $10^4 Wcm^{-2}$ makes it possible to use tracing rates of 8 ms^{-1} and initially achieving a conductivity of 500 Scm^{-1}. The laser- induced photopyroconversion thus converts and insulator ($\sigma = 10^{-14}$ Scm^{-1}) into a material with metallic conductivity. The photopyrolysis process takes place at a temperature of about 300°C [7].

Providing contacts

To be able to use the developed electrically conducting polymer made of laser-irradiated polyorganylthioacetylene in the future, for example, together with a suitable substrate material as a flexible circuit board, a printed conductor, resistor or other component, the question of how to provide contacts is of primary importance. A literature and patent search [8] showed that, internationally, no contact facilities for conductors and fittings on polymer conductors in a foil form exist in practice. Considering the development tendencies of contact methods in microelectronics, the bonding and adhesive methods appear suitable [8].

Among other methods, ultrasonic bonding was selected for these investigations on the basis of the ability of polymer foils to bear thermal loads and the intended reduction in the use of precious metals. The experiments performed using the LDB70 laboratory unit using Al-Si-1 bonding wire at the Electronics Section of the Humboldt University at Berlin showed that polymer foils in the current state cannot provide contacts using bonding. This is due to

- the flexible polyimide foil used for bonding being too thin;
- the adhesion of the photopyroconverted layer being too low;
- the conducting polymers on the flexible substrates such as polyimide foil not having the required hardness and being destroyed by mechanical stresses.

Even the previously used method of metallizing the printed conductor was not able to improve the bonding ability. Suitability for bonding can only be ensured by using stiffer base materials and achieving better adhesion of the polymer to the substrate material.

The more successful variant at this time is making contact using conductive adhesive. In the investigations performed, contacts with the polymeric printed conductors were made using the conductive adhesives C750 and C790 Mökotron (Supplier: VEB Chemisch-Technische Werke Mölkau) and the No. 105 adhesive from 3M (East) AG from Switzerland. The pronounced surface roughness of the photopyroconverted layer has a positive effect on making the connection. Strong adhesion is created between the conductive adhesive and the polymer or the substrate because the adhesive diffuses through the printed conductor. In a tearing test, the substrate material was partially destroyed [8].

The continuation of this work is directed primarily towards the use of polygraphic methods such as silk-screen printing, tampon printing or other metering principles to provide conductive adhesive meterings that are precise, reproducible and useful in a technological process.

The effect of ambient conditions on the specific electric resistance of the photopyroconverted layer

To determine concrete applications for electrically conducting polymers, it is necessary to determine the behavior of these polymers over time under the conditions of electric, climatic and mechanical loads.

The electrical contact resistance was used in these investigations as the assessment criterion. It was measured using the ammeter-voltmeter method.

Based on TGL (Technical Standards, Quality Specification and Delivery Conditions) 9203 "Test Methods" [10], the following ambient loads were selected:

- moist heat [11]
- cyclic moist heat [Db_{40}] [12]
- corrosive atmospheres (test variant 1) [13].

These load investigations were performed over a time period of 500 h. No significant reduction in electrical conductivity occurred during this time [14] [15].

Polymeric semiconductors

The production of polymeric semiconductors is based on polymeric tetrathiafulvalenes (PTTF). Undoped, these elements have an electrical conductivity of about 10^{-8} Scm^{-1}. This conductivity can be increased to about 10^{-4} Scm^{-1} by appropriate doping [16]. Iodine is the dopant and the iodine content was referenced to the TTF monomer unit (MU). One PTTF test series was treated with pyrodene (PTTF-P) to achieve improved cross-linking of the polymer chains [9].

The direct-current conductivity was measured using samples pressed into pellets. The results (Figure 1) show that the PTTF- P complexes in the undoped state have a conductivity higher by about one order of magnitude than PTTF. In both polymers, the conductivity increases with the iodine concentration. Whereas the PTTF reaches a saturation point of roughly 8×10^{-5} Scm^{-1} at a concentration of 0.6 iodine/MU, PTTF-P reached a somewhat lower plateau value of 2×10^{-6} Scm^{-1} as early as a concentration of 0.4 iodine/MU. According to the available experimental material, the electrical conductivity increases again at a concentration of 1.2 iodine/MU and achieves roughly the saturation value of PTTF at 1.5 iodine/MU [9] [14].

To additionally characterize PTTF, the direct-current conductivity was investigated as a function of temperature (Figure 2). The temperature ranges from -20...120°C. The measurement was performed using PTTF pellets having 0.4 iodine/MU. The conductivity of the samples increases with temperature over the entire

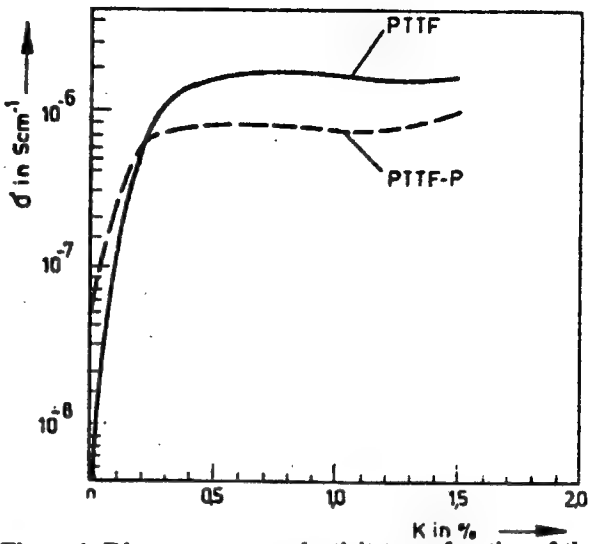

Figure 1: Direct-current conductivity as a function of the iodine concentration

temperature range. In the range from -20...40°C, the conductivity increases by about two orders of magnitude and the range from 40...120°C, it increases only by about one-half an order of magnitude [11] [14] [17].

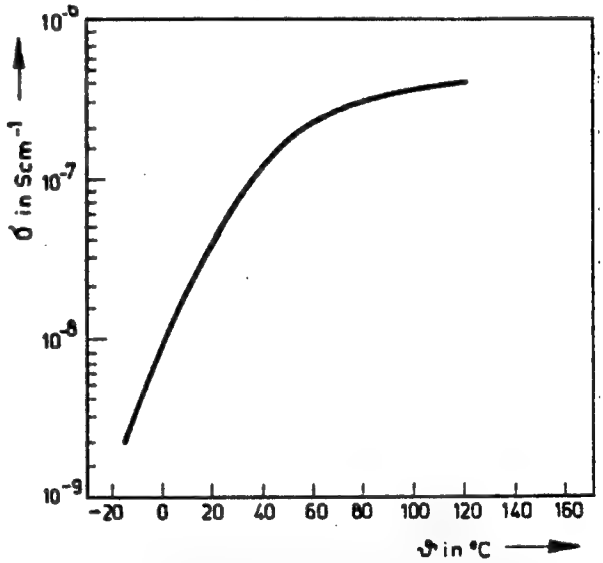

Figure 2: Direct-current conductivity as a function of temperature for PTTF

Summary

The potential of etching conductive structures in polymers described opens new perspectives for the production of printed circuit boards. Printed conductors with different resistance values can be produced by varying the etching rate and regulating the energy application by a laser. In this conjunction, it becomes possible at the same time to save steps in the process and to apply

computer technology advantageously during the design and the manufacturing phases using NC or CNC program control systems.

Further work will be concentrated on improving the electrical conductivity and the adhesion of the printed conductors. Preparatory work on the use of the bonding method for providing contacts is to be done using new substrate materials. For the adhesive method of providing contacts, the optimal process parameters such as type of adhesive, method of application, curing temperature, curing time and adhesive joint thickness are to be determined.

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COMPUTERS

GDR: Data Pool Concept for Information Exchange Described

90CW0078 East Berlin RECHENTECHNIK-DATENVERARBEITUNG in German
No 11, Nov 89 pp 24-27

[Article by Frank R. Bolz, VEB Carl Zeiss JENA Combine Computer Center]

[Text] The concept of shared data processing is the basis of the data exchange in the Combine VEB Carl Zeiss JENA (KCZ). This three-tier model provides a hierarchical structure for the implementation of computer technique at the Combine, plant and workplace levels. Currently used in the Combine are ESER installations, 16- and 32-bit SKR computers and 8-and 16-bit PCs. In early 1989, more than 1000 were in operation. Their use began predominantly with isolated solutions and required a qualified data exchange.

In order to organize an automated data exchange for the entire heterogeneous computing technique, requiring little technological service and having a uniform strategy, a data pool concept had been developed. Using remote data transfer, this concept led to the construction of a KCZ-network system /1/.

Goals for the Data Pool Concept

The data pool is not designed for one-time-only file transfer but rather it supports the steadily recurring exchange of many files among many distributed users. With the pool concept, an automated data exchange,

with effective implementation uniformly at all three tiers, was introduced in the Combine.

Automated Data Exchange

The data-pool concept makes it possible for all computers employed in KCZ to have a uniform technological interface. It is so constructed that up to 1,000 files can be exchanged daily. The volume continues to increase. This goal can be mastered only with an automated data exchange. Therefore, at the Combine level, a central CZ-data pool is permanently maintained. In all plants of the Combine, plant data pools are necessary with suitable means being available for direct access to data carriers. All plant data pools are coupled with the CZ data pool either by being steadily on-line or through offline-DFU [Daten Fernubertragung—Remote Data Transmission] (Figure 1).

Use of Available Data Banks

Furthermore, with the concept, it should also be achieved that the extensive data banks of the existing (staple) DV [Datenverarbeitung—Data Processing]-projects become available for purposes of workplace solutions and, conversely, that new workplace solutions in simple form supply the (background) DV-projects with up-to-date data.

The Combine's management uses the information exchange through the data pools for the exchange of diskette files for purposes of central reporting and also for tasks of planning and account balancing.

Decentralized Information Output

The hitherto central printing of results is being decentralized step-by-step. If the pool computer is an ESER- or SKR-computer, then, of course, larger lists can continue to be printed. However, user friendly workplace solutions have priority. Output will be produced there according to plant requirements (for example, with standard software). Through the data pool, parameters, job sequences and run protocols can also be transmitted, among others, in addition to data.

Optimized Throughput

For data exchange, the demand is, of course, always there to optimize throughput. In order to achieve this objective as envisaged by the data pool concept, the data are compressed by a special CZ-method. This function is integrated into the pool solution. Particularly great value is placed on the simple and easy mastery of the data exchange.

Support for the Workplace Level

The data pool concept can also be applied to data exchange between the plant and workplace levels. For this, data are delivered not only to the plant's pool computer but directly to the user in the workshop. For computers with terminal connections this would mean that the data, after delivery, remain in the appropriate user library of the recipient. The participant will then have normal access to his data within the workshop's terminal network.

As a component of a local computer network, the plant data pool can be the currently most effective form of data exchange all the way to the workplace. The pool is available to all participants of the workplace through the file operating system. Within the local network, the known advantages can be exploited.

Thus, the pool concept is not an alternative to local networks or to terminal systems, and is also not meant for interactive use in CAD/CAM solutions. However, it supplements these forms of use and is needed as a simple basic solution for data exchange among user groups and among plants.

In order to achieve this objective, pool organization and pool data-exchange are decoupled through the data pool concept.

Pool Organization

With the pool organization, the structure, composition and principles of program technical support for, and administration of, the data pools are regulated.

Structure of the Data Pools

Figure 1 presents the hierarchical structure with a central data pool and the associated plant pools.

Physically, the data pool is merely the data field of a direct-access data storage medium with a mass of sequential data. Every data pool has a pool number through which it can be accessed. The pool always has the function to accept files from other computers and to make them available for DV-projects, or to accept results from DV-projects and to send them to the user.

The central CZ-data pool is equipped with a 300 Mbyte on-line data capacity and is meant to provide transient storage for pool files with as brief a retention time as possible. It makes it possible, at the interface between the Combine and plant levels, to define new files simply which may at that point claim a non-central purpose.

For the plant level, plant data pools with about 30 Mbyte are required. Logically, functionally and with respect to the data the plant pool belongs to the plant level. The computer with the data pool should also function as a DFU [Daten Fernubertragung—Remote Data Transfer]-node.

In plants with different locations, several so-called nodal computers can be installed which are always assigned different pool numbers. Every pool computer has then its own pool data space and is connected with the Combine's computer center by a permanent line or through a manually transmitted data network (HDN) [Handvermittelter Daten-Netz]. The data pools should

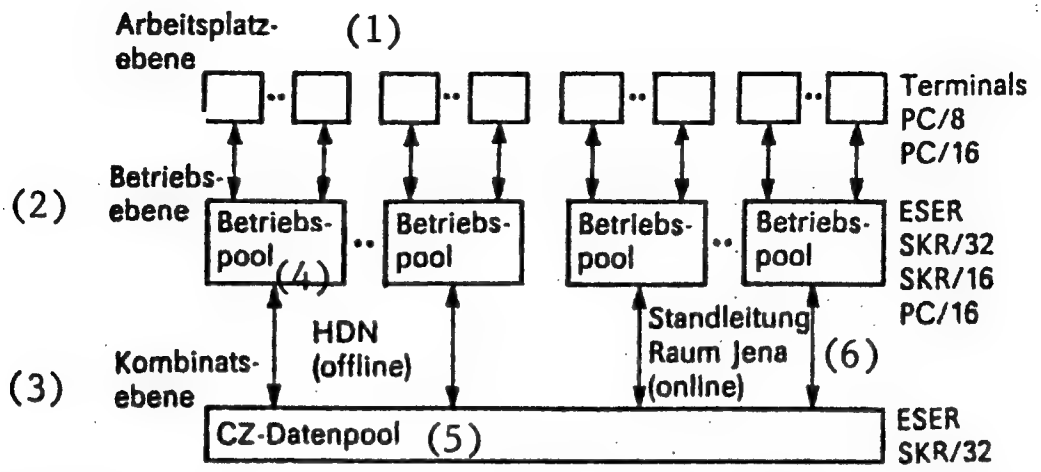

Figure 1. Coupling the Levels of Distributed Data Processing by Means of the Pool Concept

Key:—1. Workplace level—2. plant level—3. Combine level—4. Plant pool—5. CZ-data pool—6. Permanent line in the Jena area

be used mainly for the exchange of smaller masses of data between the nodal computers. An effort should be made that an individual file does not exceed one megabyte in size, as a rule. In certain cases of application, it would make sense to adapt the file organization to the pool concept. This could be done, for example, by dividing some logical file into smaller units. An example for this would be the storage of work plans in individual files. Effective work is possible through the masking principle.

Structure of Pool Files

Pool files are sequential files. The first record in a pool file is always a pool identification record which contains the file destination and sender data. The pool identification records serve the machine organization of data in- and output and the pool management. They exist only within pool files and do not reach either the DV-project or the users. Additional pool control records are the path control records which are written for every input into and output from the data pool and also for every on-line exchange. All pool control records have a defined structure and are supported by all types of pool computers. Its user length is 80 bytes. Pool control records must not be produced and employed by the user. The last record in a pool file is always a pool-end identification record. It contains the number of user data records and the number of bytes.

Pool Principles

The high effectiveness and productivity of the data pool concept is arrived at through the following principles:

—Uncoupling from DV-Project

DV-project and pool are uncoupled on all computers as a matter of principle. User programs do not write into the pool, do not read from it and do not erase. In order to manage the pool, appropriate pool programs are available for every type of computer. They will be centrally produced, also in the future, for every new computer and thereby will be made ready for uniform use in the Combine.

—Principle of Transmission

Pool files which have not yet reached their target pool, are transmitted further. This means, for example, that all other pools can be reached through the central CZ-data pool. This principle can be used in several stages and thereby leads to a hierarchial KCZ-network system.

—Accessing Principle

The pool concept is meant for files which are to be exchanged repeatedly. To that end, every file contains a functional target in its pool identification record. The rules for forming file names vary with different computers and depend on the operational systems used.

Through the use of functional targets defined in the pool identification records, file names can be formed in a computer-specific fashion.

—Processing Principle

Every entry into a DV-project contains a functional target to which files can be delivered. All files having a common target are combined and transferred to the DV-project as a single file. A pool file can have only one target. Whatever is in the pool at the start of a pool output program, gets processed. Control over different operational units must occur through different functional targets.

—Masking Principle

For selection of files, all pool programs permit a masking of the target address, the functional target, and the sender address. The generally used symbols, group masking and character masking, are used for this. With

this function, an effective use of the pools is achieved and also the automated work mode is made possible.

—Repeatability Principle

When a file is released from the pool, it is not physically erased but it is at first transferred to a BACKUP-status. This is done through renaming and insertion of the run number in the file name. Thereby all pool outputs are simple to repeat. After a certain time interval, the files are erased by masking of the run numbers.

—Security Principle

All files in the pool are secured through the pool program. Securing these files outside of the pool is not necessary. The securing of files read into the pool is done in journal files. In the event of pool output, the journal file contains only statistical data on the removed file, in the form of a journal record. If all journal files are sorted and copied together, a LOG-file is formed. These LOG-files are produced daily, as a rule. Should a pool file contain a data error, the file can be retrieved again either from the journal data space (the same day) or from the LOG-file.

The implementation of the pool principle is done for all computer types through uniform programs.

Uniform Pool Programs

For computers for which a pool organization is foreseen, *pool input programs, pool output programs and pool service programs* are available.

Thereby a uniform program-technical support is provided for use of the data pool. Figure 2. illustrates some of these pool programs in terms of a simplified data flow.

For the writing and reading of pool files on diskettes, two pool programs are available for the BC-converter, which perform the following, among others:

—writing and reading on diskettes in SCP- and DCP-format with support by the pool organization

—direct conversion from or into the dBase format

—decomposition of a pool exchange into individual diskettes

—splitting of a pool file according to a key.

The off-line data exchange with PC-workplaces which are not yet coupled on-line is accomplished with this solution.

Pool Management

In order to effectively use the pool concept both centrally and also non-centrally, an appropriate external organization with registers, indices and advice to users is required. The most important of these aids are mentioned in the following:

—Pool Register

To be able to transmit a file through a data pool, the pool number of the receiver is the most important information. Therefore, the pool register provides information about:

Part 1: the useable data pools,

Part 2: data pools in preparation

The pool register contains the following data:

—Combine workshop,

—location,

—pool number,

—type of pool computer (ESER, SKR/32, SKR/16, PC/16 or BC-converter),

—data exchange form (online, offline-DFU, transport),

—DFU-software.

Should the hardware requirements change in a plant of the combine, a new data pool can then be installed. During preparation for their installation, these new pools are carried in Part 2. of the pool register. Thereby the partners can prepare themselves for the new exchange possibilities.

—Pool file index

It is a listing of all files which can be exchanged through the data pool. The index consists of:

Part 1: submission for processing in the Combine's computer center,

Part 2: delivery from the Combine's computer center to plants of the Combine (recipients),

Part 3: exchange between plants of the Combine (CZ-pool serves only as transmitter),

Part 4: exchange between the plants of the combine workshops and the specialty divisions of the Combine's administration.

The already mentioned functional targets are provided and spelled out as specification of file content. They function in all of the pools as unequivocal names and are computer-specifically a part of the system-technical file names. The pool file indices contain, among others:

—functional target,

—file content,

—pool number of the sender or receiver, respectively,

—file type,

—pool delivery table.

The pool delivery table was originallly intended only for the central CZ-data pool. It contains, among others:

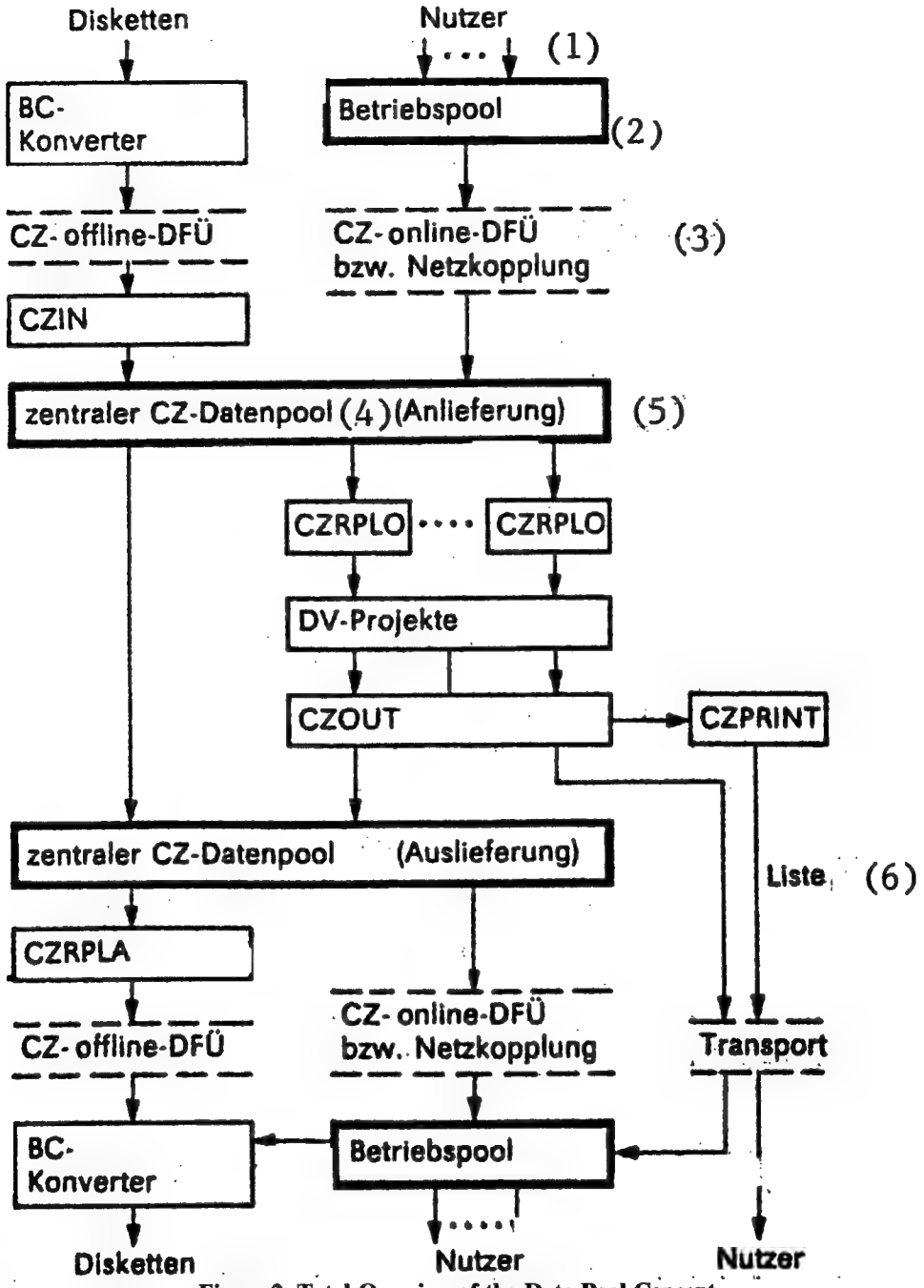

Figure 2. Total Overview of the Data Pool Concept

Key:—1. User—2. Plant pool—3. CZ-online-DFU resp. Network coupling—4. Central CZ-data pool—5. Delivery—6. List

—the target pool number,

—the specification, needed for transmittal from the target pool to the enduser,

—the functional target and

—the output form.

It became apparent, however, that this aid became necessary also at the plant level, for the management of the steadily increasing number of pool files for increasingly more endusers. This solution can be used for the plant pool in support of the distribution of pool files to the endusers.

—Pool statistics

Pool statistics are carried on every pool computer. They serve information purposes aiding the pool dispatcher and providing documentation. For this, every pool program produces appropriate statistical records which have a uniform record structure. For the central CZ-data pool, daily statistics are produced and transmitted for each associated plant pool.

They contain: target pool number, functional target, sender's pool number, type of file, number of records, pool entry date and time, pool exit date and time, and pool programs used.

Pool Data Exchange

In the Combine VEB Carl Zeiss JENA, the following heterogeneous computers are in operation:

—ESER

—SKR/32, that is, 32-bit computers such as K 1840, E 82 (USSR),

—SKR/16, that is, 16-bit computers such as CM 4/1420 (USSR), CM 52/11 (CSSR),

—SKR/A 6402,

—PC/16, that is, 16-bit personal computers such as EC 1834, A 7150,

—PC/8 including the BC converter.

With respect to the DFU-capability, these represent five different hardware concepts which must be coupled under a uniform data exchange concept. Beyond that, a data exchange form must be created which is to give good support to a steady further development of the hardware basis in the Combine's 25 plants and is to make the incorporation of future computer techniques and new software concepts possible, without complications. In order to fulfill this goal, there are system technically different forms of pool data exchange possible, utilizing the pool organization (Figure 3):

—CZ-offline-DFU,

usable with: BC-K (=BC-converter with MB [Magnet Band—magnetic tape]),

—CZ-online-DFU,

usable with: ESER, SKR/A6402, PC/16,

—Network coupling,

usable with: SKR/32, SKR/16, PC/16 (as terminal nodes).

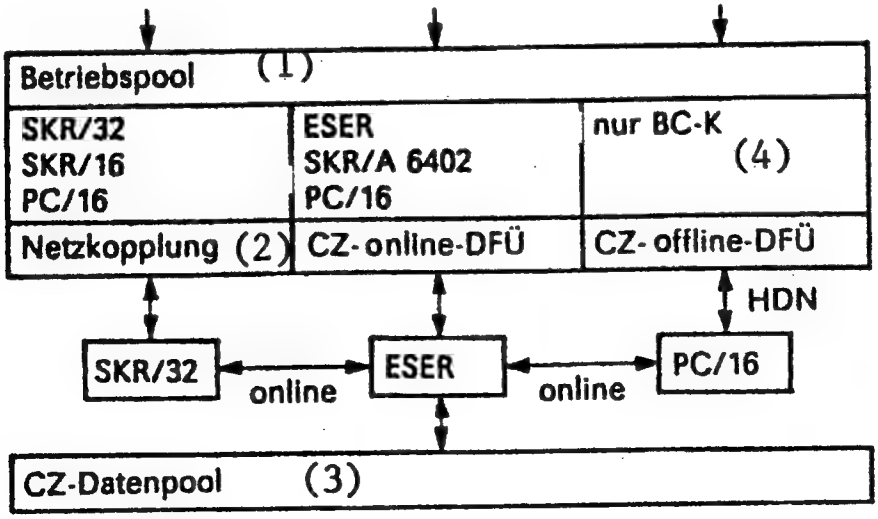

Figure 3. Possibilities of Pool Data Exchange Between Combine and Plant Levels
Key:—1. Plant pool—2. Network coupling—3. CZ-data pool—4. Only BC-K

CZ-Offline-DFU

The Cz-offline-DFU has been operational in the Combine already since 1982, that is, long before the introduction of the data pool concept, and has been developed stepwise since that time. At the present time, data are being exchanged using this solution among the Combine's plants in Saalfeld, Eisfeld, Suhl, Gera, Freiberg, Dresden, Freital, Gorlitz and Rathenow. For that, twelve connections in the manually operated data network (HDN)[Handvermittelter Datennetz] are being used. Five such HDN-connections are installed centrally in order to achieve adequate parallelness. There is no longer any physical data carrier for transport to the Combine's plants outside of Jena. For these CZ-offline-DFU, office computers A 5120/30 were expanded with magnetic tape connections to BC-converters and equipped with a V.24-interface. As modem, AM 2400s are being used which permit a transfer rate of 2,400 bit/s. Through a CZ-procedure of data compression, considerable increases in performance were achieved. Depending on the data, throughput was increased four- to ten-fold. Many plants of the Combine joined in the use of the pool-concept through BC-converters.

Through the provision of pool software for the PC/16 and SKR, respectively, and their online coupling, the BC-converters will be replaced gradually by efficient pool computers.

CZ-Online-DFU

For the online-DFU, appropriate software was developed to fulfill the following requirements

—good data throughput

For the transfer, the protocol BSC1 (synchronous, two-point connection, concurrent operation, transparent code) is used. The data are compressed.

-Accomodation to the pool organization

The files are directly written into the pool and read from it. Consequently, the files are immediately available to the receiving computer. Thereby, all of the pool principles are fulfilled.

—Automatic dispatching and receiving of the files

Incoming files are written directly into the pool data space; files to be sent are automatically selected by means of masks and are also directly transmitted.

—Synchronous transmission

The BSC1 protocol was selected for transmission. Concurrent operation and transparent data transmission occur. Data are checked by the CRC-procedure with the ESER-polynom.

—Corrective support

Fast response in case of technical component failure. Switching to off-line output.

—Automatic re-start after line disturbances and computer failures

Without special service handling, resumption of file transmission.

—Register indicator

Information possibility for the user whether or, respectively, which files pertinent to him are included in the pool. This solution was set up for ESER, for EKR/A 6402 and for PC/16 and permits all coupling variations among them. It is currently installed with permanent lines within a 10-km area and used by eight plants in the Jena area.

Connection is achieved over V.24-interfaces

—on the ESER through the EC 8404.M1 or the EC 8371.01.

—on the SKR/A 6402 through the MUX

—on the PC through synchronous adapters.

As modems, GDN K8172 with a transmission rate of 9,699 bit/s are used. In routine operation, net transmission rates of eight [sic] 800 byte/s have been reached. Through the additional compression of data, the same high effects are being achieved as with the offline-DFU.

The CZ-online-DFU always serves one line in a two point connection and can function in three operational modes:

1. Dialogue operation (recall operation)

In this mode, a CZ-online-DFU program is served by commands with another computer operated in the server mode.

2. Server operation (background operation)

In this mode, the CZ-online-DFU can receive commands from the partner, carry them out, and transfer the results back to the partner. All commands named for operation in the dialogue mode are possible.

3. Automatic transfer of files

At certain time intervals, the pool data space is searched for files to be transferred. The times and masks for the selection can be provided at the start of the program. The selected files will be sent automatically. While in the waiting situation, the program operates in the server mode, that is, it is ready to receive data. With these modes of operation, the CZ-online-DFU responds to all of the established pool principles.

Network coupling

An efficient on-line coupling with the network software SKRnet/3/ is possible between SKR/32 computers.

Therefore, no individual solution had to be produced for these computers. For sending pool files to the pool of the receiver, a procedure was made available which carries out the following functions:

—file selection from the pool data space and transfer into the sender data space

—placing the file into BACKUP status in the pool after completed transfer and the production of transmittal statistics

—transmission of the file(s) from the sender data space to the receiver data space of the target pool by means of the SKRnet

—writing of the file(s) from the receiving data space into the pool of the receiver, automatic name assignment and production of receiving statistics

—placing the file into BACKUP status in the receiver data space after completed acceptance by the pool.

With this uncoupling it was possible to accomplish full pool organization, observing all of the pool principles, and yet to install the efficient network software. The additional use of the sender and receiver data spaces in the process has proved itself. It allows for high stability, security and transparency. Thereby the disadvantage of intermediary buffering is compensated.

The connection of PC/16 is similarly possible and will be achieved with the uniNet/4/ network software of the Management Center for Application Research of the Combine Data Processing. With uniNet, the PC/16s are operated in an SKR-network as terminal nodes.

Both network software solutions are currently operated by GDNs for the pool data exchange within a 10-km-area. The net data rate is in this case too around 800 byte/s. A comparable network software is also available for SKR/16 from the Information Center of the TU [Technical University] Dresden. In order to implement the data exchange concept in the KCZ-complex, an on-line coupling between SKR/32 and ESER must be used. The pool data exchange takes place at this interface of an on-line solution, which is described in /2/. This coupling uses a coaxial cable connection between the ESER-control unit EC 7922 and the SKR-bus on SKR/32.

Pool Access for the Online-Dialogue User

The possibilities for pool data exchange described so far are set forth mainly for computer couplings. For ESER-dialogue users who work on PC/8 or PC/16 in the emulation mode, as TSO- or PTS-users, a direct pool access was installed. Using the MOVESTAR-components of AdW [Akademie der Wissenschaften—Academy of Sciences] Berlin, a CZ-specific application, MOVEPOOL, was produced. It offers the PC-user, in near or remote coupling, a menu driven, well prepared pool access for the sending or receiving of files. For the PC, the known emulator programs of VEB Chemical Facilities Construction Grimma and of VEB Robotron-Project Dresden /5/ are used.

Also for SKR-dialogue users, pool access can be achieved directly on the PC/8 or PC/16.

Use of the Automated Data Network

The pool data-exchange concept is used exclusively through the permanent connections and in the manually operated data network of the German Post Office. Further technical and system-technical development for the KCZ will take place upon transfer to the automated data network of the GDR. It is planned that every data pool will be connected to the automated data network and will use the packet-mediated transfer possibilities.

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GDR: Approach to Distributed Data Processing Described

90CW0099 East Berlin RECHENTECHNIK-DATENVERARBEITUNG in German No 12, Dec 89 pp 5-7

[Article by Gunter Wiedemann and Rudi Richter, Data Processing Center, Dresden: "Magnetic Media Exchange Enables Distributed Processing"]

[Text] As the use of decentralized computer systems in the GDR becomes broader in scope, the need for distributed data processing in its various forms becomes increasingly important, i.e. in addition to autonomous utilization of workplace-related technology, there is an increasing demand for cooperation among systems in a local area network as well as with respect to existing mainframe projects which have been tried and tested over many years. These requirements are being met by the enterprises of the Data Processing Combine within the following guidelines:

1. The performance of data processing tasks should occur at that location at which such tasks can be effectively carried out; criteria for such realization are expense, response times, availability of technology, reliability, potential for cooperation, and adaptability of the solution.

2. Use is to be made of the advantages of decentralized computer technology, its availability, proximity to the workstation, capability of on-site processing and subject-oriented evaluation.

3. Due to increased performance parameters and resources, and the resulting hardware and software options, the use of centralized computer technology is to be increasingly aimed toward the areas of mass data processing and centralized projects such as scheduling, coordination and evaluation of large amounts of data.

4. Continued use is to be made of existing, proven ESER solutions, while simultaneously employing decentralized technology using "centralized concepts and organization and decentralized processing."

Developments in technology today allow centralized EDP capabilities to be brought closer to the users, and therefore closer to the processes. Methods by which this can be accomplished are:

- Interactive access to resources in the VEB Data Processing Center enterprises, in particular direct access to large-volume data resources,

- Remote data transmission, transfer of data,

- Use of the computer communication network (RKN) of the Data Processing Combine, and

- Different types of distributed processing using on-line and off-line media exchange.

The above points provide a basic outline of the need for and the potential of so-called distributed processing. (Definitions, types and areas of application were described in detail, for example, in the February 1989 issue of EDV-ASPEKTE.) The following discussion illustrates practical solutions in this area and presents experience gained in the exchange of magnetic media—one form of distributed data processing which is often used in cases in which the "rough edges" have not yet been removed from on-line transmission paths or in which mass data with short processing cycle times are concerned.

In addition, in the organization of distributed processing tasks, this method is to be viewed as an entry-level method and/or one to be used if all else fails. The exchange of magnetic media in the Data Processing Combine involves half-inch magnetic tape in most cases—a format which is widely used for mass data and equipment availability (transfer technology available to the user). However, the diskette is becoming more and more important.

PCESER—Hardware and Software Solutions in Magnetic Media Exchange

The goal is to collect and check data on diskette using the workstation computer directly at the source of the data. This procedure eliminates the intermediate processes of primary data collection, transfer to media acquisition, storage on machine-readable media, elimination of errors, etc., thereby improving quality and saving time.

The processing of data collected in this manner can be immediately continued within the limits imposed by the capability of the workstation computer. Data entry is performed in parallel at the ESER computer, as well as the processing of projects which can only be effectively carried out on mainframe computers due to the large amount of data, computing speed and printing requirements involved. Condensed data generated by the project are back-converted to diskette in the form of text or REDABAS files by the ESER computer, after which processing continues on the workstation computer. Lists which are small enough to fit on a diskette can be output to diskette and processed by means of an associated auxiliary program without project modifications.

There are several ways to transfer the data to a mainframe computer:

Off-Line Method

Magnetic tape drives are installed in the A 5120/A 5130 office computer or other such decentralized system. The data are transferred from diskette to magnetic tape using software produced centrally, such as the MB program. The magnetic tape file thus generated can be immediately processed by the ESER computer. It is also possible to transfer the data from magnetic tape to diskette. This intermediate step is suitable only for small amounts of data, and requires additional personnel.

Remote Processing Method

Workplace computers are directly connected to mainframe computers via a V.24 interface and telephone lines owned by the postal service, and transfer data via this set-up. The disadvantage of this method is the sophisticated technology involved, as well as the slow speed of the procedure, as a long distance telephone line must be available to each user. Within the mainframe computer, a comprehensive control software package then receives and further transports the data.

The KIF Adapter Method

The EC 1834 is available with a KIF adapter. The KIF adapter is connected directly to the local TSO or PTS video terminal control unit. This arrangement allows the byte-by-byte transfer of data. Powerful software for the preparation of the data, however, is not yet available.

On-Line Method

In the Data Processing Center, Dresden, a method was developed which enables diskette files to be directly processed or created on the ESER computer without requiring any additional equipment.

The technical solution is extremely simple: A PC 1715 is connected to an EC 7902/7902M punched tape station

instead of a tape reader/punch being connected to the station. The control unit interfaces with the PC just as it would a tape reader or punch. No technical modifications to the punched tape station itself are necessary. An additional card must be inserted into one of the expansion slots of the PC 1715. Otherwise, no modifications are made to its standard configuration.

The data transfer rate between the PC 1715 and the ESER computer depends on the multiprogramming factor and the speed with which data are input to the PC from diskette. It has been shown in practice that the transfer of a 780 KB file takes a maximum of 12 minutes. Because this process runs with minimum operator attendance, the operating personnel can take care of data input from diskette while the process executes.

The SCP operating system of the PC comprises the DKREAD and DKWRITE programs, and the OS/ES operating system of the ESER computer contains the PCESER1 and PCESER2 programs.

The DKREAD program is responsible for file allocation, reading the diskette data and data transfer to the punched tape station. Proper operation is verified by sending control records at the beginning and end of the data transmission process. During data transmission, the DKREAD program is responsible for synchronization and error handling. Errors are printed to the screen, and the message "Eingriff erforderlich" ["operator action necessary"] at the ESER computer indicates that the operator must intervene at the PC. A synchronous check character appears at the beginning and end of each record sent. In order to run the program, the operator need enter only the name of the file to be transferred. At the end of the file transfer process, a prompt asks the user if several diskette files are to be chained to form a single ESER file. The end of each file is indicated by the "operator action required" message at the ESER console. If several diskettes are processed during one transfer session, the operator must make sure that all of the diskettes have the same track format. Diskette files created using the DCP operating system must be converted to the SCP format.

The DKWRITE program then outputs the data to diskette. Synchronization and data handling are performed as in the case of the DKREAD program. To run the program, the operator indicates only the number of the drive to which the file is to be output. The filename is generated via the control card or the database name of the ESER file, and is transferred to the DKWRITE program by a special control record.

Only one file can be generated in a given program run. It is not possible to change diskettes in the middle of a file transfer. The program PCESER2 was written in order to allow the output of large groups of data which must be stored on several diskettes. This program allows the first diskette to be filled to capacity, at which time the user is prompted to insert a new diskette and restart the DKWRITE program.

The ESER computer must run under the OS/ES operating system. Computer centers which use the DOS operating system can, on their own, adapt the programs introduced in the following via the source programs. For this operating system, connection to the PC takes the form of a punched tape station. The I/O macro GET is the software used to input data to the ESER computer from the PC, while data are output to the PC using the I/O macro PUT.

The PCESER1 program requires approximately 32 KB of memory, and is written in assembly language. The PARM parameter in the ESER control statement is used to select the direction in which transfer is to occur. It is possible to selectively restart the program beginning with the last file, or to restart it such that it reads in an existing magnetic tape file from the A 5120/5130. The following functions can be selected using the control statement:

- Conversion of ASCII characters to DKOI characters, or vice versa - Modification of the standard conversion table - Packing and unpacking of fields - Masking of characters - Insertion of constant character strings - Decoding of hexadecimal values - Generation of REDABAS 2 files - Chaining of several diskette files to form a single ESER file - Preparation and output of lists, or direct printing.

When the program is executed, control records are exchanged between the ESER and the PC. Only after several check sequences ensure that the ESER and the PC are working properly together can the actual transfer of data begin.

To each record to be transferred are added special check characters which ensure that the data transfer procedure runs

correctly. At the end of the file, control records are again exchanged; among other information, these records contain the total number of records transferred as a check. A comprehensive checklist contains all activities, such as filenames, numbers of records, program restart parameters, etc.

The PCESER2 program is an expansion of PCESER1, and supports only the transfer of records in the ESER computer-to-PC direction. The user can select from among the following functions by means of control statements:

- Specification of maximum diskette capacity, and operator prompt to change diskettes when 98% of this capacity has been reached

- Determination of the structure to be converted (packed, hexadecimal, etc.)

- Selection of individual words and characters

- Insertion of decimal or hexadecimal characters or character strings

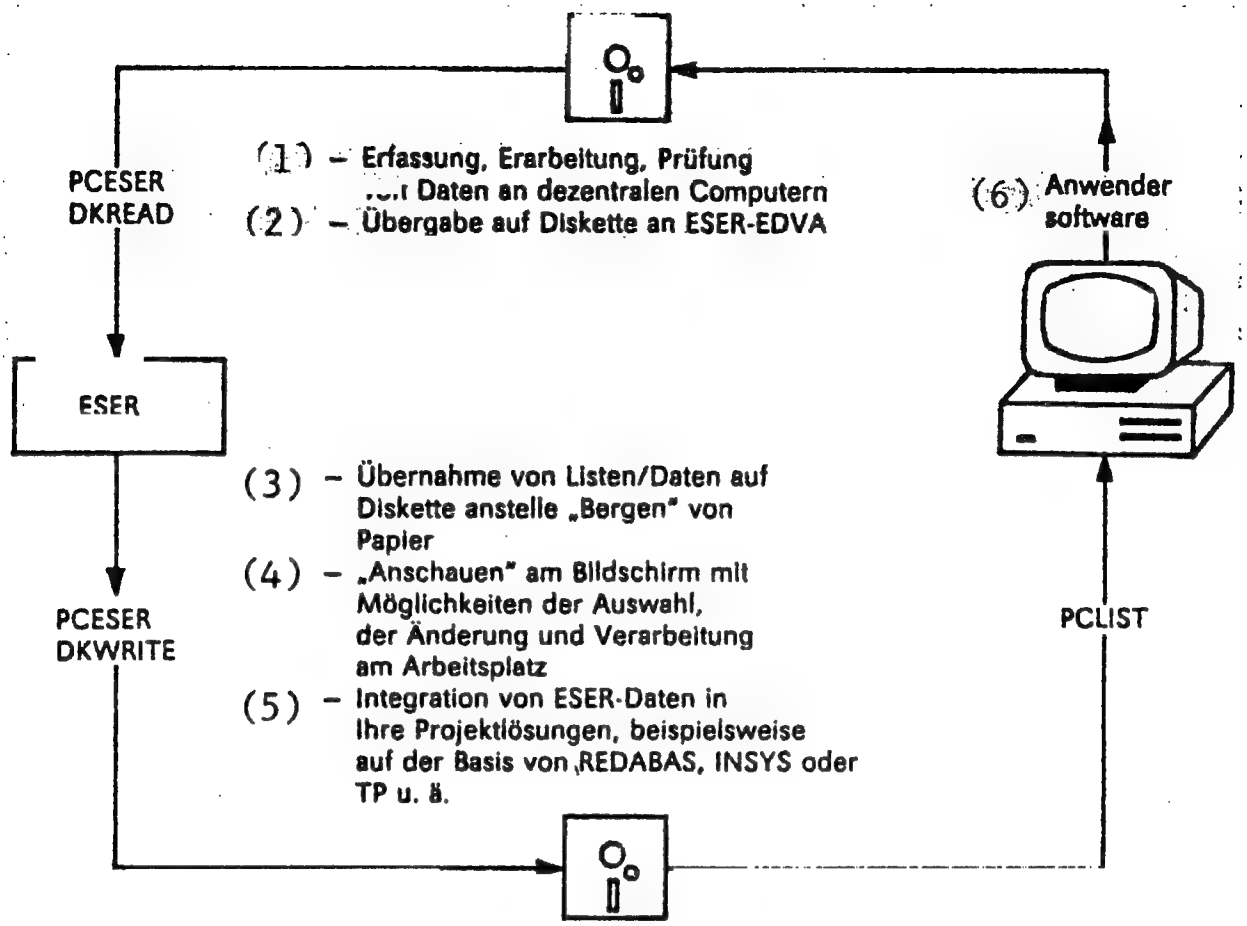

Figure: Diagram of Diskette Transfer Between an ESER Computer and a PC

Key:—1. - Collection, generation and checking of data on decentralized computers—2. Transfer via diskette to ESER EDP system—3. Transfer of lists/data on diskette instead of "mountains" of paper—4. Viewing the data on-screen with the ability to select, modify and process data at the workplace—5. Integration of ESER data into your project solutions, for example REDABAS-, INSYS- or TP-based data and the like—6. **User software**

- Selection of records using IF ... THEN conditional statements

- Generation of REDABAS 2 files, text files or files with a fixed record length

- Ability to convert ESER list files to PC list files.

PCLIST Software for Working with ESER Files on the PC

Further processing of the prepared data pertaining to an ESER project in file or list form at the workstation computer is facilitated by PCLIST.

A clear menu guides the PCLIST user through the following functions:

- Browse through lists or files by line or column - Highlight selected fields or columns - Go to specific lines, columns or search strings - Invoking/selecting headers - Selection of different screen scroll rates - Selection of a list header, which remains fixed on the screen for each page of the list - Generation of an additional file from the existing one based on all selection parameters. One can, for example, select certain portions of a file. - Line breaks as desired, with the remainder of the line on the next line or page - Selection of individual fields within the line - Positioning within the file - Selection of records based on field contents - Ability to delete, insert and change lines - Entire file or part of file can be printed. The printer can be set up to print up to 160 characters per line on 24 cm wide paper.

[Boxed item, p 6]

With seven ESER EDP systems, of which two are EC 1057s, the VEB Data Processing Center, Dresden, is today one of the largest data processing centers in the GDR. Experienced software development collectives laid the groundwork for the economically efficient use of ESER technology.

Complex EDP projects for local State agencies, the domestic consumer goods trade, and the forestry, foodstuffs and motor vehicle industries have found broad-based application in the GDR, and represent the heart of automated information processes in these fields. In addition, since the founding of the Data Processing Center in Dresden, experience gained in the field of production planning and control has been increased, and has been compiled and made available for use by others in the form of a "modular software applications package for operational production planning and control in order-based and commodity-oriented production (PPAG)". [end boxed item]

Using well-known text manipulation procedures, PCLIST offers services in addition to the ability to browse through a text. These additional features include, for example, overwriting, modifying, deleting or supplementing information; the original file is not destroyed. At the same time, a copy can be output at the printer (either the complete text or text excerpts, with text modifications, line breaks, modified page breaks, etc.).

User Experiences

Experience gained in practical use to date in the Data Processing Center in Dresden indicates an ever-increasing need for this process. To date, roughly 20 large-scale projects have been carried to conclusion, making extensive use of the exchange of diskettes between decentralized computer systems and the ESER computer.

The majority of the transferred files are text and REDABAS files, and the converted ESER data sequence is set up so that no operator intervention in the project is required.

In processing new projects, this technology is given consideration beginning at the very start of the planning phase. A large number of users are thus able to dispense with the uneconomical punched tape and punched card media, while simultaneously importing data into the project which have been checked for proper syntax and content. The sequence of operations used in the past in processing data—printing a list, correcting the list, preparing a machine-readable data sequence, cleaning up the original data, etc.—can be dispensed with.

Working in parallel is highly efficient. The important step of preparing the data can be performed on decentralized computers independently of the ESER project, thereby saving time and money. Integrated systems such as INSYS, developed by the VEB LfA in Berlin and operated together with the VEB Data Processing Center in Dresden, facilitate the generation of files, texts, spreadsheets and projects.

Because this database system can also process REDABAS files, it is also suitable for planning and working with files.

Almost all clients who use diskette files for inputting data to the ESER computer, also use the system in the reverse direction. From condensed data, REDABAS or text files are output to diskette and are further processed using the operator's own applications software at his or her workstation.

A large group of users take advantage of the capability of generating selected master files using ESER project data for use in decentralized data processing projects. Several references have already been made to the output of data in list form on diskettes.

The employees of the Data Processing Center in Dresden themselves use the exchange of diskettes in their own projects, and increasingly for the performance of the test, without neglecting the modern interactive processes TSO and PTS. At the workstation computer, source programs and job streams are configured as a text file, and input to the ESER computer by means of PCESER1 in 80-byte format, where they are then processed. The program PCESER2 then outputs the text data to diskette again. After any necessary corrections are made to the programs, job streams and test files, the diskette is then transferred again for the batch test.

In order to accept job streams with simultaneous syntax checking for the OS/ES operating system and the acquisition of source programs, the VEB Data Processing Center makes use of the program JOBESER which runs in the DCP and SCP for 8- and 16-bit computers.

The exchanging of diskettes as a type of distributed data processing is still in its infancy. Continued use of powerful workstation computers forces a distinction to be made between mainframe and small computer tasks. The type of solution presented here is highly recommended as long as there is no interactive processing or direct data input and output between different types of computers.

The software products PCESER and PCLIST introduced here are supported by the Software Applications Center of the Data Processing Center, Dresden, and are made available for use by others. Please direct all inquiries to the Data Processing Center, Dresden, Software Applications Center [VEB Datenverarbeitungszentrum Dresden, Applikationszentrum Software], Dr.-Otto-Nuschke-Str. 20, PSF 408, Dresden, 8028.

GDR: DDS Distributed Data Processing System Described

90CW0101A East Berlin RECHENTECHNIK-DATENVERARBEITUNG in German
No 12, Dec 89 pp 18-19

[Article by Dr Wulf Lammert and Dr Bernd Loscher, VEB Data Processing Center, Schwerin: "DDS—An Elementary System for Distributed Processing"]

[Text] The use of software systems with distributed data processing is urgently needed in order to guarantee

universal and forward-looking handling of problems as well as a logical link between various databases.

DDS was developed with an orientation towards practice at the Data Processing Combine, and since 1984 more than 100 DDS installations have been set up. Ongoing further developments include LAN (local area network) and WAN (wide area network) plans, multidatabase systems, and DDS components for 32-bit computer systems.

Characteristic Features of the DDS System

The DDS system makes it possible to logically connect PC standard software tools with standard ESER database solutions. Using his work station computer (PC), the user accesses data in central computer systems. The user needs no special knowledge of the structure and accessing paths for large computer databases; he simply formulates which information he would like to have filtered out, and as a result he receives data excerpts. On the PC end, DDS can optionally provide these selected data in various popular data formats.

ESER databases are data organizations with long-term stability whose data definitions, such as record and field structure, have emerged historically or are specially equipped for optimal computer operation. When accessing remote data, the user of the DDS system only has to know which terms can be found in this or that database. Through menus, he chooses on the BC/PC the data files and fields whose contents he needs on his PC. In addition, the user can stipulate conditions and field comparison values in order to control database evaluations even more closely. After the requests are processed in the computer center, the user receives result data, which DDS transforms into the standard user environment (TP, REDABAS, INSYS). These data can be interactively evaluated on the screen.

For physical data exchange (remove data processing or off-line exchange of data media), DDS does not provide any separate components. For this, all the known solutions can be used (e.g., DD62, CCSMV, DATRA, MOVESTAR, MB, DKON, REKON, ...). Released from this, he can use DDS to prepare a series of queries for various remote databases and provide closed physical transport for them.

Extract:

DDS is understood as a system that:

- organizes logical access to physically remote databases with a uniform query language,
- transfers result data in formats desired by the user,
- controls ESER processing sequences, and
- effectively organizes the transfer of data.

For control time, DDS recognizes two nodes, on which several different databases can be installed. It can be regarded as a control and transformation system over various data-holding systems. In this way, it can be integrated into existing user applications at a later date, without additional project expenditures.

Applications: Batch Mode—Collecting Transactions at the BC/PC

At the BC/PC, the user of the DDS formulates his transactions (TA = queries) using menus. Each of the transactions is stored in a transport file. Characteristics of the transport file:

- can contain several queries (TA),
- several queries can address several databases or files,
- several users can store queries in a single transport file,
- the transport file can be responsible for one or more ESER projects,
- besides queries, the components data (e.g., REDABAS, TP, ...), DDS metadata (e.g., formulated on the PC and transported to ESER), and startup commands can be included to call in any ESER programs for joint transport to the target computer.

At the agreed moment the transport file is moved to the remote computer (ESER) using magnetic tape conversion, remote data transmission, etc.

The joint transport of transactions and data reduces costs and organizational expense.

Separating at the ESER

At the remote computer, the transport file is assigned to one or more projects. Prior to project processing, the components of the transport file,

- queries
- project data, working papers, JCL, etc., and
- metadata

are separated. Conventional ESER projects can be effectively controlled under DDS with the separated project data. This is generally joined by DDS processing in order to release the RA (respond to queries).

Responding to Queries and Collecting the Result Data at the ESER

Queries are called in successively by DDS and converted to result data. DDS controls necessary types of access, and in so doing uses database management systems such as TOPAS, DBS/R, DAFEMA, etc. to access project data, or activates its own program components for access to sequential data.

The result data thus obtained are immediately stored in a transport file. At the end of ESER processing, the DDS provides the current course protocol for transport. These transport file is transmitted to the BC/PC user.

Separation on the BC/PC

The BC/PC user evaluates the course protocol. Upon request, result data (contents of the transport file) are transformed by DDS into the desired user environments,

such as REDABAS, INSYS, etc. In the basic solutions, e.g., REDABAS, INSYS, it is then possible to continued working with these transformed data right away.

Dialogue Mode

In general, TSO and PTS are available as dialogue systems on the ESER. A subscriber point can be a non-intelligent terminal (such as EC 7920) or a BC/PC with the corresponding emulator program (such as EM62, MOVESTAR, TSX). In dialogue mode, only queries in direct connection with the ESER computer system are processed by DSS. This precludes the need for a transport file on the BC/PC.

- Formulate queries: The DDS user formulates his queries on the screen in a command language based on REDABAS.
- Transformation of the formulated queries: With the dialogue components of DDS, the formulated queries are converted to the internal DDS format.
- Respond to queries: The DDS dialogue mode is then continued as with batch mode, with responses to the queries. A transport file is created, which can be supplied to the BC/PC user, depending on need (e.g., via MOVESTAR).

Other Modes

The application cycle described above (batch mode) also applies to the coupling variations that employ a 16-bit PC as a central node. In this way, the REDABAS-3, INSYS, and ALLDBS databases, among others, can be reached through query-response. Computer systems under the SCP, SCP1700, and DCP operating systems are acceptable as BC/PC at all points of the DDS system.

DDS is generally applicable for mass projects. Thus, application-specific limitations are not set out by the technical problem. The applications should demonstrate this through the example of more than 100 subsequent uses:

- VEB DVZ Dresden: Project on housing policy, evaluation of DBS/R databases by the councils of cities and kreises,
- VEB Building Material Supply Combine: Project on planning building materials, access to central TOPAS database by bezirk-led enterprises of the VEB Building Material Supply,
- VEB Fishing Combine, Rostock: Searches in predominantly sequential and TOPAS-oriented database by planning collectives within the enterprise.

Continuity and Progress

Local and global computer networks can be regarded as the logical next step in the broadening use of microcomputer systems in al areas of society. The increasing decentralization of computer technology and information processing means intensified communication for the individual user. Databases stored in information processing systems should be as free of redundancy as possible, but at the same time consistent and neutral. Central database management systems can potentially reduce organizational costs. Extracted data (copies) are permitted only for marked processing cycles on local computer systems.

The following are job classes for standardized computer networks and the system solutions based on them:

1. Transport of user data in the computer network (FTAM).

2. Remote order processing (remote operation: RO), job-transfer and -manipulation (JTM).

3. Communication systems (mailbox and teletex).

4. Access to distributed databases in homogenous systems (RDA).

5. Expansion of access mechanisms to non-homogeneous data interfaces.

6. Development of a complex, distributed database management system with automatic access synchronization.

Job classes 1 to 4 are covered by initial OSI network implementations or by network-capable data management systems. Access to distributed databases includes various methods for synchronizing read-only and write-only access (often as a full responsibility of the individual user).

For job classes 5 and 6, efforts at standardizing have yet to be completed. For some user groups, de facto standards have become established, such as SQL, compatible REDABAS interfaces, SDF data formats, etc. However, for network software systems in job classes 5 and 6, theses are not adequately neutral, so that application-specific interfaces result. Standardization organizations will evaluate the situation and soon establish generally valid guidelines on the basis of initial user experiences.

A logical data network with non-homogeneous data storage systems requires (beyond the computer network technology):

- uniform user access at all nodes of the distributed system (query system in keeping with QBE, SQL),
- a neutral data exchange format, independent of individual database management systems such as TOPAS, REDABAS, INSYS, etc., and
- neutral metadata and catalogues for managing a distributed system.

The DDS demand parameters meet the above requirements for a logical data network.

The DDS system fits in with plans for modern computer network and multibase technologies.m The emphasis here is realizing a distributed database management system (VDBV system) with heterogeneous data interfaces.

Within the framework of further job processing, improvements in the control output of all DDS components to become a DDS multibase system are being encouraged. In the process, rules for the transfer of data under application networks of the OSI reference model, as well as rules for the structure and content of catalogues, metadata, etc, must be described.

Preconditions for Application

The DDS system has been tested for the OS/ES operating systems MVT, MFT, SVS, and MVS. For the PC/BC user, DDS applications in the SIOS, SCP, SCP1700, AND DCP operating system environments are possible.

Hardware:

8-bit PC/BC: PC 1715, BC A 5120/30 and compatible computers;

16-bit PC: EC 1834, A 7150, A 7100 and compatible computers;

ESER: ESER series I and II;

Software:

8-bit PC/BC: SCP operating system and CP/M-compatible databases: REDABAS, TP (SL variable), physically fixed;

16-bit PC: SCP1700 operating system and compatible computers; databases: REDABAS, TP (SL variable), physically fixed; operating system: DCP; databases: REDABAS, ALLDBS, TP (SL variable), physically fixed;

ESER: All OS operating systems, as well as PTS, TSO dialogue systems; database: TOPAS (2.0 and above), DBS/R, DAFEMA, sequential access to QSAM, BSAM, BDAM, BPAM files.

GDR: DASTI-DAFEMA Technical Database System Described

90CW0100A East Berlin RECHENTECHNIK-DATENVERARBEITUNG in German
No 12, Dec 89 pp 10-13

[Article by Juergen Ruhland, "Erich Weinert" VEB Measuring Instrument Plant in Magdeburg, Dr Wilfried Voss, and Peter Schreiber, VEB DVZ in Magdeburg, BT Stendal: "DASTI-DAFEMA—Database System for Technical Information"]

[Text] In replacing DOS computer technology at DVZ in Magdeburg, the "Erich Weinert" VEB Measuring Instrument Plant in 1986 faced the job of converting all previous programs to the OS system.

An important part of the data was stored in the BASTEI technological database. Form an operational viewpoint, this task coincided with the adoption of a new technological record system and the introduction of productive wages. The following premises were formulated for the work of the project collective:

- Introduction of a new database system for technological information
- Extensive use of the enterprise's local computer technology
- Guarantees of rapid, direct access to the central database by using remote data processing
- Introduction of the TABII record system to the operational organization
- Conversion of the revision service for technological documentation
- Reprogramming of the user projects, which had previously worked with the BASTEI database, to the new data and system basis

The primary tasks to be carried out within the framework of DASTI-DAFEMA were:

- Central storage of technological documentation (APSK/ML)
- Information system (screen dialogue) of technical information for the subject areas of technology, design, preparation for production, and material planning
- Revision system for technological documentation (divided working task)
- Database for user projects: printing the technological order record (TABII, determination of normative data MZA/AZA and MVN, determination of medium-term need MZA/AZA, calculation of the medium-term material plan, determination of operative material need (preliminary order placement), and determination of the operative parts need
- Database for local jobs by swapping out selected information for special departments and operational elements

Scheduling had to be done in keeping with the circumstances involved in introducing productive wages in such a way that the programs for storing and providing maintenance for the technological data, as well as printing the order record, could be converted to stabile, permanent operation by May 1988.

Potential Solutions for Distributed Processing

Selection of an available DBBS [database operating system] as the core for the technological data processing system was undertaken according to a number of criteria.

The decision was made in favor of the DAFEMA (database operating system with remote access by DVZ Magdeburg). Among other things, the following were factors in the decision:

- Rapid record or object locating within large volumes of data;
- Relational management with properties minimizing memory space;
- Multistage standby system in keeping with international standards;
- Integrated remote processing support with procedures, menus, and templates;

- Preparation and expansion of effective interfaces for distributed processing;
- Special CAD/CAM support features by the DBBS for object-oriented memory storage in composite structures until release of dialogue parts list;
- Possible integration of user programs and adaptability of previous BASTEI programs.

In addition, the decision was influenced by the fact that a significant part of the computer output by MGM Magdeburg is furnished by DVZ Magdeburg, and that the DVZ development trends for DBBS DAFEMA and other software products (DATRA, ESERLAN, RTV2000) are in keeping with ideas about integrating computer output with the operational organization.

The planning group thus decided on the following formulations:

1. A technological data base will be installed on an ESER main computer, with the following relations:

- Subject data (GD)
- Material list data (SD)
- Work cycle data (AD)
- Material master data
- Order data.

From the information contained in these data files, normative data for the material consumption standard (MVN) and for working and machine time expenditure (AZA/MZA) are created for planning models, and are stored in the separate DBS data files.

2. The BC/PC technology available in the enterprise will be connected to the database via a data line to the ESER computer at DVZ Magdeburg; the BC/PCs are connected as terminals of the main computer by way of emulation software.

3. The revision service for the database uses a distributed method with comprehensive use of intelligent work station technology.

4. Data files for updating the database or for local processing programs from the database are made available through a data transfer.

5. The special departments for technology, preparation for production, and material planning can directly and interactively access the database.

6. Search procedures that have been compiled in advance are available for querying the contents of the database.

7. Complex revision functions are largely avoided for the interactive dialogue. For work on local computer equipment, it was determined that the data files should be transferred in text format and that REDABAS should be used as the programming language.

The database is integrated in the enterprise organization on three time levels: daily dialogue time from 7:00 a.m. to 4:00 p.m., daily batch service beginning at 4:00 p.m.

Acyclical batch jobs at large time intervals are processed after the batch service is effected and on weekends.

Dialogue With the DASTI-DAFEMA Database

In November 1986, a pilot program was set up as a text and program development system, and in March 1988 hot-run operation was begun for the basic technological data files, GD, SD, and AD. During the daily interactive dialogue time, the stored data in the remote inquiry system are available. Queries by the special departments are performed using the data manipulation language or with procedures compiled in advance. The data manipulation language of the DBBS DAFEMA is well-suited for formulating simple queries quickly and without extensive prior know-how. However, its range of performance also extends to comprehensive, complex searches. Selected searches are stored in memory and are available to the user as reusable procedures. In daily practice, queries that are made with particular frequency include the contents of APSK and material lists, the use of materials and components, cost-center and machine-group allocations, etc. Furthermore, structural release is a system query that is continually in demand.

The goal is that the searches be structured in such a way that the response time is less than 10 seconds. This requirement is supported for the user by the selection of defining arguments, which are stored in separate search data files. These defining arguments were selected on the basis of experiences with the BASTEI database. The data model for our system was structured in such a way that the data were stored on the basis of the enterprise documents. This resulted in a method of storing material and component terms that is not free of redundancy, but that does represent a simplification of searches. Thus, the revision service for these data words had to be realized automatically throughout the entire database. Previous experience has shown that relatively constant queries are made of the system in the areas of preparation for production and material planning. The time load is also not of major importance with these areas. Organizationally speaking, daily dialogue availability cannot be limited for this area. Remote data processing quality is monitored by a control system in the computer system.

On-Line Data Transfer to the ESER Computer

The remote data processing time is used at the same time to prepare for batch services. The batch jobs performed daily consist of a series of constant processing jobs and several involving modifications. Among the constant jobs are updating the master data and backup functions for the data files. The jobs that can be modified include printing the technological order report (TAB), swapping out onto magnetic data media, and list printouts.

The special departments can write corresponding requirements into data files in the main computer. The

data needed to update the technological information are transferred directly to the ESER computer from a BC A 5130 using DATRA software.

The same software is used to meet the needs for TAB and other batch jobs. There are input sections rooted in the DAFEMA procedure library for a series of list printouts and for swapping out APSK and ML structures in preparation for the technological revision service.

During dialogue time, input data for batch jobs that are not effected on a daily basis are also transmitted.

Upon conclusion of file transfer from the local computers to the main computer, a job record is transferred into a special file. This record contains the specifications for preparation of the batch service. The work preparation group at the computer center prints this record out.

There is a accident-oriented variation on the process for file transfer and job record preparation, whereby the necessary data are converted to a magnetic tape and transported to the computer.

Large-scale, non-rush input data are converted to a magnetic tape and transported to the main computer.

Control of ESER Batch Jobs

Like all ESER jobs, the DASTI-DAFEMA daily batch service is subject to job network control. Processing begins with the transfer of data in keeping with the needs of the special departments. Several fixed channels for APSK and ML are available for these jobs. In addition, there are transfer channels for the master material file and for compressed data on working time expenditure calculated for planning models. Three channels with different record lengths are freely available.

The revision service for technological information performs extensive data checks. The special departments always provide the revision programs with complete structures, which have been checked for syntax and semantics. If the structures already exist in the database, then the data records are exchanged in the same place. This method ensures a very high degree of utilization of the available data area, so that reorganization of the database was not necessary even after a running time of 1 year. Logically dependent revisions are automatically effected by the revision program. New records for the enterprise's permanent files are produced from the revised structures.

Record requirements for technology are then processed. The TAB is printed out in a special processing segment. In the programs, a check is run on whether all the documents to be output are found in the data files. The special department can specify parts of the document printout in the indicated job record. In all, eight documents are produced on six different forms.

In another processing step, extensive searches or optional list printouts can be performed.

Finally, the database performs its security function. DAFEMA features a separate security system that overcomes any accidents with a high level of success.

If there is an interruption in processing, the system automatically restores the processing status before the interruption and tails the changes made since that point. This form of recovery is also practiced during dialogue time.

For intermittent processing jobs, there are job networks equipped with optional segment control. Even without extensive preparation through preparatory work at DVZ, a high degree of processing variability can be realized here.

The information from the database can be called in both directly, using search files, and sequentially. Several focal points have developed for our applications.

In particular, these relate to the structured release of technological components and finished products, the single-stage release of material lists, and supplementing them with APSK data and master material data.

The data records prepared in this way then go to the projects for determining material consumption standards, machine and working time expenditure standards, technological direct-unit costs, and preliminary material placement.

Local Software Basis

The remote data processing user's entry point to the local software is the KON1 program for the K 8921 concentrator, which transmits the messages received through the dedicated line to the connected PCs and BCs and thus permits a high level of potential use of the ESER resources and of the data line.

In the dialogue variant, the BCs and PCs work as terminals with the SIOS operating system (later SCP or DCP). A two-wire dedicated line at 2400 baud in duplex mode is used.

The input files for batch processing are present in the special departments as sequential REDABAS select files. Using the operational data network (SCOM-LAN by IHS Wismar/Warnemuende), these files are transferred to an A 7130 BC. From there, they are transferred on to the main computer using DATRA (file transfer by DVZ Magdeburg). Accident variation: conversion of the files to a magnetic tape with DHMBGWT (VEB DVZ Halle).

The data is transferred from DVZ to the enterprise on magnetic tapes. At present, up to 15 files are transferred daily. These files are then converted to diskette, whereby DHMBGRD (DVZ Halle) and MB (State Planning Commission) are used as conversion programs. The files are rerecorded to the user through the LAN, and transferred in the special department in REDABAS format. Integration in the P-8000 system is also ensured for various swapped-out data. In the technological special

department, the local processing programs for technological information are combined in a complex REDABAS system. This system performs processing jobs from regeneration to evaluating APSK and ML data diskettes. Swapping the data in and out for the main computer projects is also carried out as part of this system.

Further Development of the Processing System

At present, planning on the further development of the local system comprises three target directions:

1. Expansion of the number of DASTI-DAFEMA base files from 9 to 11 by integrating the design parts list in the database system.

2. Introduction of the DAFEMA6 system.

The new system will perform clustering, which will mean more effective use of computer time; at the same time, new processing methods (modules for parts list release) should be used.

3. Establishment of a parallel-running DAFEMA system for jobs in material planning and calculation (MAWI-DAFEMA).

Storing the design parts lists requires new operational controls which are currently in the formulation phase. Development work on the DAFEMA6 system, the DAFEMA dialogue-parts list processor, and related applications, as well as on the object revision service in composite structures (DAFMOLEK) and dialogue controls for batch segments (DAFEMA-SEGT), has essentially been completed and successfully tested in industrial applications.

On the local side, further development is under way on the operational organization for using LAN possibilities.

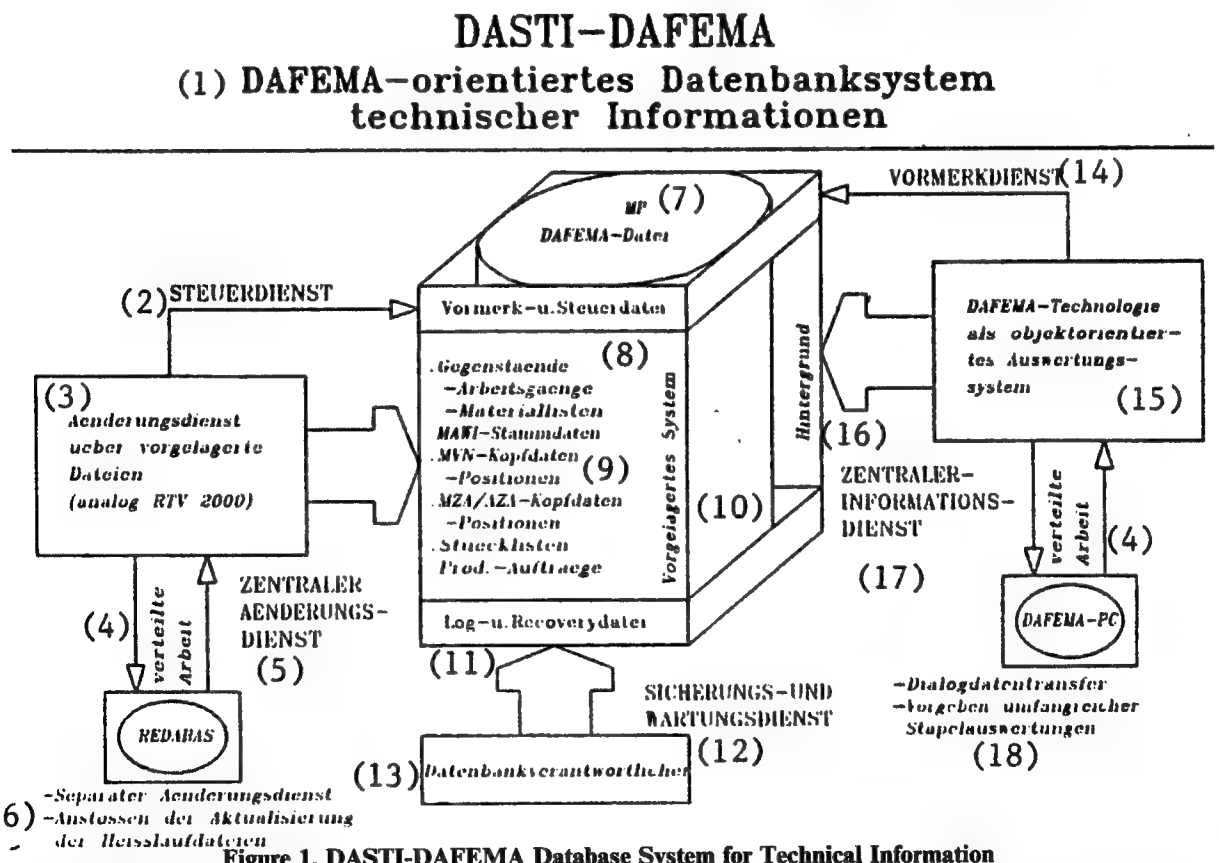

Figure 1. DASTI-DAFEMA Database System for Technical Information

Key:—1. DAFEMA-oriented database system for technical information —2. Control service—3. Revision service for prestored data files—4. Distributed work—5. Central revision service—6. Separate revision service; initiation of update of the hot-run data files—7. MP DAFEMA data file—8. Standby and control data file—9. Objects (processing steps, material lists); MAWI master data; MVN head data (positions); MZA/AZA head data (positions); parts lists; production orders—10. Prestored system—11. Log and recovery data file—12. Safety and maintenance service—13. Person in charge of the database—14. Standby service—15. DAFEMA technology as object-oriented evaluation system— 16. Background—17. Central information service—18. Dialogue data transfer; output of extensive batch evaluations

At present, the ESER-LAN software product, by DVZ Magdeburg, is being introduced in stages for further use in SCOMLAN. Through the possibilities offered by this system, we can increase the number of users of remote data processing without increasing the size of the control system needed to activate and deactivate data stations. Data transfers to and from the main computer will be simplified. The option of swapping out data from the database using the LAD-AUS [LOAD-OUT] function will be possible interactively, so that the user at his work station can have rapid access to the necessary information. An effort is being made to reuse the DAFEMA-PC software package based on a 16-bit LAN variation for this purpose. We will integrate a P 8000 in the LAN as a file server. Besides promoting more effective work within the network, this new possibility, created by IHS Wismar/Warnemuende and the Measuring Instrument Plant, should result in an improvement in distributed processing in those special departments that lack direct access to the central database.

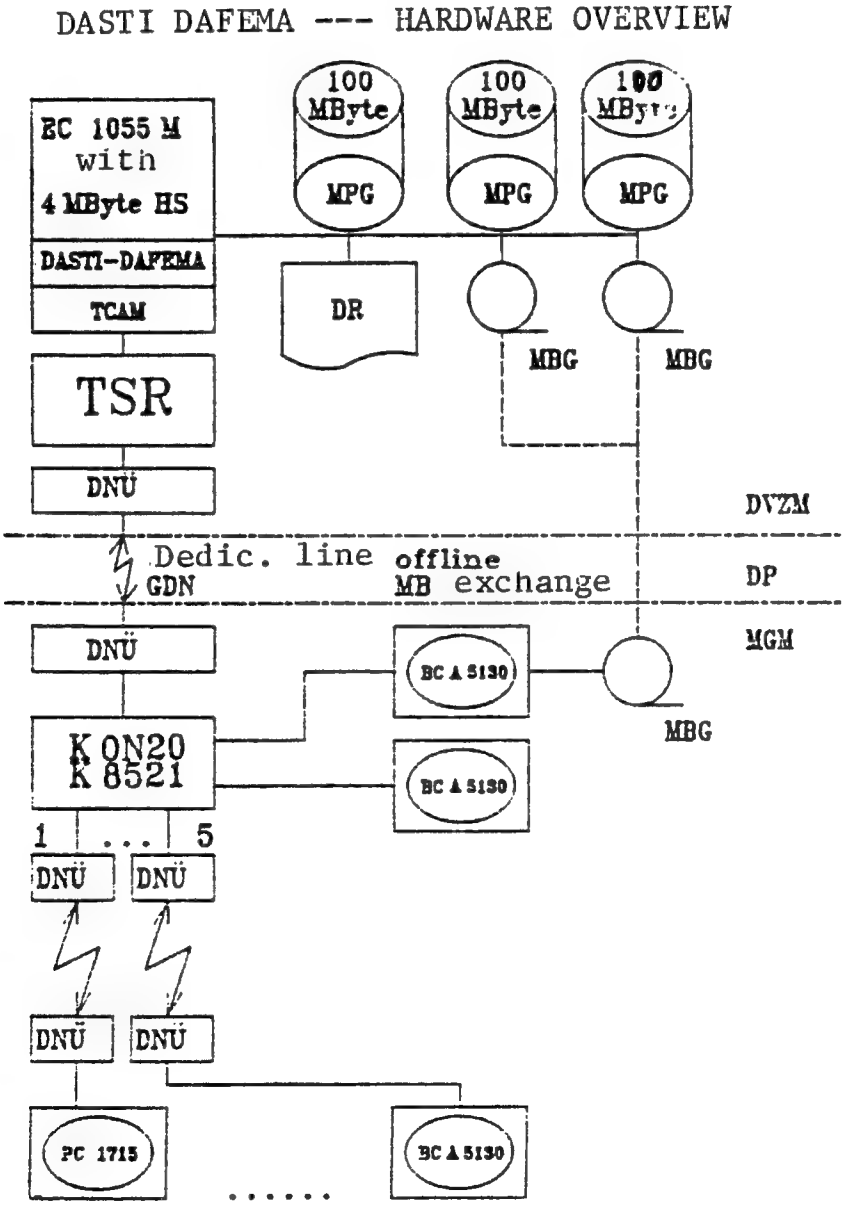

Figure 2. Hardware Overview for the DASTI-DAFEMA System

GDR: Use of ROLANET-1 With P 8000 Computer Described

90CW0077 East Berlin RECHENTECHNIK-DATENVERARBEITUNG in German
No 11, Nov 89 pp 20-21

[Article by Ulf Boehl, Dr. Claus Sattler, Frank Tzschaetzsch, Academy of Sciences of the GDR, Institute for Computer and Information Technology: "Use of the P 8000 With ROLANET-1"]

[Text] The uses and performance of local nets interlinking a large number of personal computers are increased considerably when they are integrated with efficient computer resources, also known as servers, which offer the following services:

—Fileserver, with a large background storage for storing user files;—Printerserver, which has a calligraphic capability when a special printer is attached;—Mailserver, for managing user-related mailboxes; and—DV-server, to which the user can hook up as a terminal from his personal computer.

Our experiences with using ROLANET-1 in the office environment, on the other hand, show that direct dialogue between two users working on a PC (using the dialogue components of ROLANET-1) plays a secondary role. This can be explained as follows: First, the telephone extensions included in the local nets as an alternative communications medium are rarely problematic and offer wider possibilities through verbal communication. Second, the recipient of an incoming message is disturbed in his work at the PC. And third, there is no way of knowing when sending a message that the intended recipient is currently at his PC to receive it. The communications device (CD) software of the PC 1715 or A 5120 can be loaded from a diskette. That of the K 1520 can also be loaded from PROM disks. For computer configurations without a disk drive, software can also be loaded via the local net, for which a PC 1715 or A 5120 must be available. ROLANET 1 /1/ offers Mailservers under SCP Fileserver and based on PC 1715. For this kind of work, using diskettes quickly reaches its limitations.

Few users have a K 1600 at their disposal that can be attached to the ROLANET-1. Attaching the EC 1834 to ROLANET-1, as proposed, opens new server possibilities. The P 8000 is a 16-bit microprocessor system based on the U 8000 processor, which is equipped with a hard disk. A typical configuration contains two to three terminals and a printer. The WEGA operating system offers multiuser operation and multitasking. Attaching the P 8000 microprocessor system to ROLANET-1 had the following goals in mind:

—using the P 8000 with its hard disk as a Mailserver;—using all WEGA functions and even file transfers between PC and P 8000 from the PC via the local net; and—using the WEGA operating system to couple one P 8000 to another via the local net.

Because it was not possible to develop a special LNC1 local net controller for the P 8000, it was coupled to the local net with a communications device (CD), which is constructed either on the basis of a PC 1715 or A 5120 or out of standard groups of the K 1520 system. The CD and the P 8000 are coupled via a V.24 interface.

Communications Device

The CD consists of the following hardware components of the K 1520 system:

—CPU card with 3 KByte PROM and 1 KByte RAM as well as PIO and CTC;—RAM card 64 KByte;—2 PROM cards 16 KByte;—interface card 2 V.24; and—LNC card.

The CD contains OSI-applicable communications software for layers one to four. The X.25 Paket Level Protocol is implemented in the net layer. The transport layer can use an OSI-applicable net service, on which a transport protocol of class 0 is mounted. Using OSI-applicable communications software was in the interest of research. A tighter integration of the ROLANET-1 transmission software has also been achieved in the meantime. The transport layer allows the simultaneous operation of several connections (to a maximum of six), which can lead to one or several applications on the P 8000. The applications correspond to various Transport Server Access Points (TSAP) and are differentiated by the TSAP identifier. After calling up a TSAP through an application on the P 8000, a transport connection can be made from a PC to this application via the local net. The transport (T) interface is available not on the CD, but on the P 8000 (Fig. 1). Therefore, the CD contains a corresponding coupling software to transmit T-interface data units.

Coupling Software

The task of the coupling software is to pull the T-interface from the CD (T-service producer) onto the P 8000, to which the T-service users are connected. In addition to the secure transmission of interface data units, the coupling software is also tasked with assigning information to the individual applications. This results in the following subdivisions for the coupling software:

—physical layer, which transmits individual characters;—block transmission layer, which transmits blocks of up to 256 Bytes securely and without error;—information transmission layer, which assigns information to the applications.

The transmission of individual characters occurs asynchronically via a V.24 interface. The maximum transmission rate is 9,600 baud. In order to guarantee error-free transmission, the transmission is protected with a block transmission protocol. The block transmission layer transmits blocks securely, repeats transmissions in the case of error, and indicates errors.

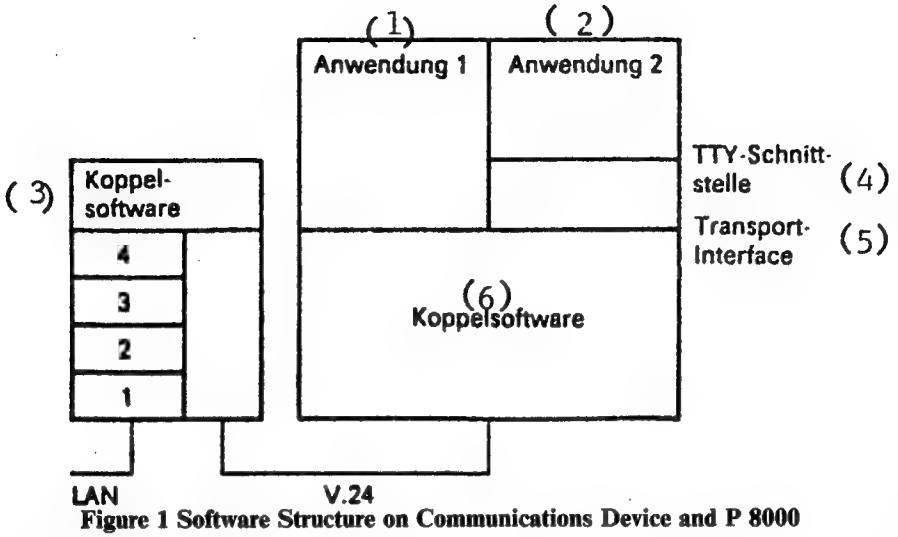

Figure 1 Software Structure on Communications Device and P 8000

Key:—1. Application 1—2. Application 2—3. Coupling Software—4. TTY-Interface—5. Transport Interface—6. Coupling Software

Assignment of the T-interface data units to the T-service users takes place in the information transmission layer by means of a user identifier.

Communications Software on the P 8000

The coupling software on the P 8000 is integrated in the operating system. Its task is to make a transport (T) interface available to the individual applications. The transport interface is based on a character-oriented device drive interface with the following functions:

open—opening the drive *close*—closing the drive *write*—sending data to the drive *read*—receiving data from the drive *ioctl*—influencing the operational mode of the drive.

Several channels can be used to access the device drive. This assumes that each channel has been assigned a TS-application, i.e., a user identifier. The user of this channel is responsible for producing and evaluating the T-interface data units.

Two types of application are possible:

—direct use of the T-interface by means of the application. This allows OSI-applicable applications (layers 5 to 7), among others, to be used. The mail management system described in /2/ presents such an application.—indirect use of the T-interface by means of the operating system's tty-handler, whereby PCs connected via the local net can use all the WEGA functions as terminals of the P 8000.

Indirect use of the T-interface creates an application with separate TSAP and user identifier. Subchannels are provided for parallel indirect use of the T-interface. The software for imaging the terminal interface onto the T-interface is also integrated into the WEGA operating system. It images a subchannel on a T-connection. Opening and closing the T-connections is accomplished with the functions *open* and *close*. The subchannels can work in two modes when opening connections:

—passive mode (after implementing the open function, the user must wait for a partner system to open a connection)—active mode (after implementing the open function, the user attempts to establish a connection with a partner system).

The error-free conclusion of the open routine signals the user that the T-connection has been opened successfully. The T-connection is available for data transmission by means of the subchannel. Ending the T-connection is accomplished with *close*, but only if the last user of the subchannel closes the terminal drive. The signal HANGUP notifies the user that a T-connection is being shut down. At the interface, the subchannels act like local terminal channels (tty-channels). The tty-handler is used for input and output, which allows for normal work conditions at the terminal. It is recommended that passive subchannels be used as login channels and that active channels be used for coupling with other P 8000s. The operating mode of the subchannels, as well as the addresses of the partner systems for the active subchannels, is determined when the operating system is generated.

Terminal Software

The terminal software available to PCs using the CP/A operating system makes it possible to use the P 8000 as a work station by means of the LAN. This software assumes that a user process (generally getty) on the P 8000 must wait for a connection to be opened. The T-connection is opened from the terminal, whereby the user can choose the partner system.

After a connection has been successfully opened, all acquired data is displayed on the screen, and all characters input with the keyboard are sent to the P 8000. The screen drive, by means of which the data is displayed, emulates a VT 100-type terminal, so that screen-oriented programs can also be run without problem. In addition, the file transmission protocols for the WEGA program getfile/putfile are implemented in the terminal program, so that an existing connection for file transmission between PC and P 8000 can be used.

Performance Evaluation

Transmission rates of 800 to 1,000 Bytes can be achieved for terminal use, so that complete screen formatting takes 1 to 2 seconds. In transmitting files between the P 8000 and the PC, effective transmission rates of approximately 200 Bytes were achieved. The same transmission rates resulted when files were transmitted between two P 8000s, but bear in mind that file transmission occurred in the background.

Possible Uses

The coupling presented here offers a multitude of application possibilities, of which only a few can be mentioned:

—All functions of the P 8000 can be used with the terminal software from a PC 1715 or A 5120 connected to ROLANET-1. WEGA-DATA offers a data bank system, among other things, so that many users can access a data bank via the local net.—The file transfer available with the terminal software allows file transmission from (to) the diskette on the PC 1715 or A 5120 to (from) the hard disk of the P 8000. This opens possibilities for archiving files, including the organization of work-related processes when working with files.—The file transfer between two P 8000s over the local net can be initiated from the terminal.—By coupling the P 8000 with other computer systems by means of serial V.24 interfaces, complex net structures can be created, in which transmitting files and using remote computer resources are possible (Fig. 2). It is also possible to use the services described above jointly by means of various ROLANET-1 nets, and to use the P 8000 as a Mailserver by using the mail management system /2/.

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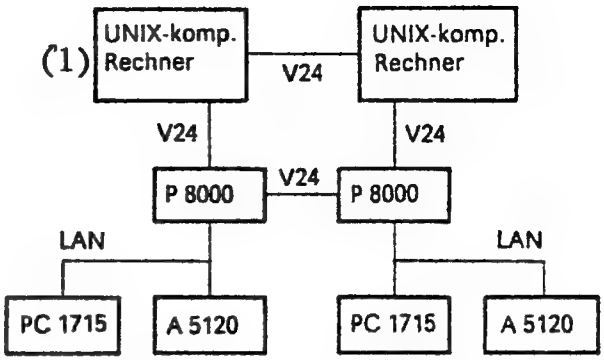

Figure 2. Complex Net Structure Including Local Nets
Key:—1. UNIX-compatible computer

GDR: 32-Bit Microprocessor for New ROBOTRON Computer Generation

90CW0080 East Berlin
MIKROPROZESSORTECHNIK in German
No 11, Nov 89 p 322

[Article by Erfurt Microelectronics Combine: "First 32-Bit Microprocessor From Erfurt Makes New Generation of ROBOTRON Computers Possible"]

[Text] In addition to the development of a broad range of products, great significance is attached to the development of cutting edge products as prototypes of new technologies for the 1990's. In the solid state circuit field, development of efficient microprocessor systems as an entree into VLSI technology and development of dynamic memory prototypes were established as central state objectives in the Directives of the 11th SED Party Conference. Upon fulfillment of these objectives, it will be possible for the GDR to meet the demand for VLSI solid state circuits from its own national resources and thus create a foundation for the necessary breadth of products in the corresponding strategic economic sectors, specifically in computer technology, control electronics, and information technology.

Preliminary developmental work for the GDR's first 32-bit microprocessor system began in September 1986. Based on GDR requirements, emphasis was placed on an efficient system for producing high performance workplace computers. In addition to individual components already available as a result of other developmental objectives, it was necessary to develop 12 LSI and VLSI circuits into a unified system. The heart of the system is the 32-bit U80701 microprocessor, integrating approximately 130,000 transistors on a chip surface of 85 square millimeters. This microprocessor permits construction of a workplace computer with a capacity for 1 million operations per second. The clock rate is 40 MHz. The U80701 manages a 16-MB physical memory and a 4-GB virtual memory. It has an integrated memory management unit (MMU). It also has a page-based protection mechanism (512 bytes per page) as well as access protection management. One hundred seventy-five machine commands may be used. All commands are orthogonal

in structure and permit all of the 21 different address modes for each of the maximum of 6 operands. For those commands not implemented through the hardware, emulation is supported at the operating system level. Registers include 16 32-bit-wide general registers as well as 20 processor or internal registers. The processor contains a clock generator and a bulk voltage generator. The system's 12 integrated circuits are produced by the Erfurt Microelectronics and Carl Zeiss JENA combines. Specific design software for LSI logic circuits such microprocessors was developed and successfully tested on the prototype of the 32-bit microprocessor U80701.

The new 32-bit K1820 computers from the VEB Combine ROBOTRON built with the 32-bit microprocessor system are fully compatible with the 32-bit K1840 computers available in the GDR and with internationally dominant products in 32-bit technology. The current major areas of application of the computer are

- Design of complex automation systems
- Control of fully automated factories
- Information systems to guide the economy
- Design of LSI circuits and complex multilayer PCB's
- Robot controls
- Telecommunications, satellite control.

The K1820 may be networked without problems. Thirty-two or more monitor-equipped workstations may be connected to a single computer. Independent tasks may be performed in parallel on these workstations.

With the support of the U80700 system, virtual memory management is possible, permitting multiuser and multitask use in connection with internationally distributed operating systems. Thus, all modern interactive demands of various users are possible, and computer capacity can be used for background processing.

Linking of multiple computers permits distribution of tasks through actively connected redundancy so that the failure of any one computer has virtually no repercussions for the user.

The K1820 has no special installation requirements and may be integrated into any workplace because of its small size.

Compared to the 8-bit U880 microprocessor system used to date in the GDR, a ten-fold material savings is achieved.

The high resolution color graphics possible in engineering workstations with the U80700 (on the order of 1 million pixels, several 100,000 colors) and interactive capabilities permit use for sophisticated design and graphics functions.

Of particular significance are the capabilities for linking engineering workstations via efficient, i.e., high speed, data communications processes. Three fundamental problems have been solved with this networking potential: First, there is an efficient base for transfer of data and information between several computers (even over long distances). Second, the utilization of common resources—for example, expensive peripherals such as mass memories and electrostatic plotters—by several engineering workstations is supported. Third, it is possible to increase the computer capacity available to the user through interconnection of several engineering workstations.

With the U80700 system and the 1-mbit U6100 DRAM, the GDR microelectronics industry now possesses all the prerequisites for the design and production of highly complex logic systems. The necessary design tools were developed cooperatively by the microelectronics combines, the microelectronics user combines, the Academy of Sciences, and the institutions of higher education of the GDR.

Special technology with two metal layers was developed for the 32-bit microprocessor. The modern production facilities of the Erfurt Microelectronics Combine are based on a clean room design developed in the GDR and use cutting edge technological equipment from various GDR combines as well as imports from the USSR and other CEMA countries. All crucial materials used are produced in the GDR: Silicon wafers from VEB Trace Metals Freiberg, high purity chemicals for semiconductor technology from VEB Laboratory Chemicals Apolda, ceramic housings from the Hermsdorf Ceramic Works Combine, sensors from the Teltow Electronic Components Combine, paint systems from the OROWO Combine as well as items from numerous other combines. The GDR has thus succeeded in providing its own comprehensive infrastructure, beginning with circuit design based primarily upon ROBOTRON Combine's computer technology and extending through its own production capabilities in modern clean rooms all the way to supplying important materials. Furthermore, modern test systems to verify all qualitative parameters in compliance with international standards are being developed and produced in the Microelectronics Combine.

The results achieved in the GDR in recent years in the development of sophisticated solid state circuits form a strong foundation for a modern national economy. This foundation will guarantee stable supplies of the extremely large variety of VLSI circuits for industry from the GDR's own domestic resources.

Microprocessor Operating System Described

90CW0081a East Berlin
MIKROPROZESSORTECHNIK in German
No 11, Nov 1989

["An Interactive Real-time Operating System"]

[Text] MES is a configurable real-time operating system based on the U880 microprocessor system. It can be expanded to suit a particular task by building on a small kernel. Up to 255 tasks can be processed on a priority basis and in real time using the functions implemented in the kernel (Figure 1). The minimum cycle time of a

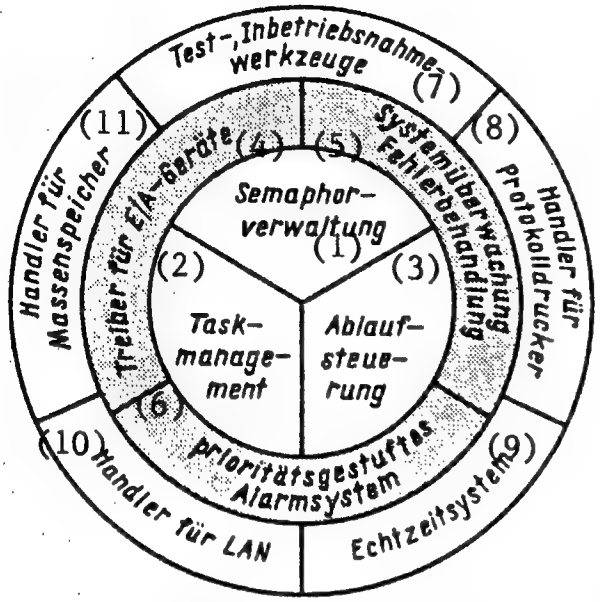

Figure 1. Components of the MES real-time operating system

Key:—1. Semaphore management—2. Task management—3. Process control—4. Drivers for I/O equipment—5. System monitoring, error handling—6. Priority alarm system—7. Testing, start-up tools—8. Handlers for logging printers—9. Real-time system—10. LAN handlers—11. Mass storage handlers

task is 1 tick (which can be generated and is at least 10 ms). There is virtually no limit on the maximum cycle time.

MES implements dynamic tasking. Tasks create other tasks either during initialization or execution. In this manner, the number and selection of the tasks in existence at one time can be affected by the current state of the system or its environment (on-line reconfiguration). All system services can be used via interrupt service routines. This provides the user with extensive facilities for reacting to external events. The operating system has 16 semaphores for synchronizing access to global resources. The semaphores may be used directly for task synchronization if necessary.

The system kernel of MES incorporates monitoring routines. These routines check for the proper execution of tasks and system- internal processes. If an error occurs, these routines start automatic correction measures. They also prepare a message or stop the system, depending upon the seriousness of the error. The *Error Handler* system component is available for managing the message, the display of these messages as a system alarm, and the acknowledgment organization. This component also can be used for annunciating process alarms and other error sources in the form of a system call. A real-time monitor supports the use of MES in process computers. This monitor consists of complex monitor routines and drivers for keyboard inputs and display outputs. The most important of these monitor routines are: - Character string input (echo on display) - Numerical input (echo on display), made available as a hexadecimal number in registers - Alternative decision (echo on display) - Numerical outputs (1 or 2 bytes, hexadecimal or decimal representation) - Character string output - Erasing sections of the display - Input and output of a character - Password prompting to check the operator authorization for protected programs.

The keyboard driver suspends calling tasks waiting for keyboard input for the duration of the monitor operation. Depending on the selected input mode (e.g., numerical input), the driver does a syntax check (the type and number of the characters entered) after the input is declared valid (ENTER). If it detects an error, the driver starts a standard message and acknowledge mechanism. The interface for this mechanism is also accessible by the user (e.g., for semantic checks). When the input operation concludes, the keyboard driver restarts the suspended task. The display is subdivided into several physical and functional areas. These areas are administered by the operating system as resources (header line, graphics section, dialogue section, areas for priority messages). This ensures that different categories of alarms and system errors are displayed virtually in parallel. They can be acknowledged via the assigned special keys independent of the dialogue and display operations of an operator.

MES supports the integration and start-up of application programs with a real-time debugger and easy manual control of tasking and of the mass storage medium. All the software tools available under SCP can be used for program development. For interactive work, an MES version is available under SCP.

MES provides interrupt-controlled drivers and handlers for printers (IFSS) and mass storage media (MFS 1.6, FS 8" or magnetic tape) with an SCP-compatible recording format. The monitor may be generated for alphanumeric controllers with 80 x 24 characters or the VIS2A graphics controller. The K7672.xx or K7643.xx types can be incorporated as the keyboard. The system kernel contains a memory management system for up to 250 KB to accommodate various memory cards.

MES can run both on systems with ROM and those with RAM and has been installed on OEM computers and end products (K89xx, IPC8). Based on MES monitor routines and system calls, a broad spectrum of configurable application programs for the tasks of a control- room computer is available. The MES real-time operating system is being used in industrial applications for process-control computer and master computer configurations.

Universal I/O Bus for GDR's P8000 PC Described

90CW0075 East Berlin RADIO FERNSEHEN ELEKTRONIK in German No 11, Nov 89 pp 696-698

[Article by Dr.-Eng. Ralf Rieken and Axel Dittrich: "Universal I/O Bus for P8000: Announcement From the Information Technology Department of the Karl Marx City Technical University"; first paragraph is RADIO FERNSEHEN ELEKTRONIK introduction]

[Text] In this report a universal, parallel I/O bus system for exchange of large quantities of data between different processing systems is introduced. It was developed specifically for the P8000 PC.

Objective

Creation of an efficient image processing and developmental system was necessary for implementation of research tasks in the area of digital image processing. The P8000 system, which offers a favorable environment for efficient software development through the UNIX-compatible WEGA operating system and available hardware resources (multiple terminals, fixed disks) [1], was selected as the platform. Essential hardware enhancements include the connection of the P8000 with a group of peripheral computers to drive various devices (raster display units, video recorders, graphics printers, additional autonomous image processing systems, see Fig. 1). As master, the P8000 system has the following functions:

- Support of program development with WEGA tools
- Control of peripherals
- Furnishing backup media for additional autonomous image processing systems.

Very large quantities of data are typical of all image processing tasks. Thus, even a gray-scale image with the relatively low resolution of 256 x 256 pixels with 8-bit amplitude quantification occupies 64 K of memory. During processing of image sequences, it is frequently necessary to store and process several megabytes of data.

Possible Solutions

The simplest solution by far is the use of the serial interfaces of the P8000. Because, on the one hand, the majority of the 8 printer channels are already occupied (terminals, printers, developmental hardware) and, on the other hand, the transmission rate is inadequate for the requirements of image data transmission, this possibility was rejected. Another alternative is the use of several parallel channels. The P8000 has 5 expansion slots, 4 of which are currently occupied by memory assemblies. The boards are 140 mm x 150 mm. Two parallel interfaces may be provided on each board. To gain additional slots, the 256-K memory assemblies must be replaced by a 1-MB assembly.

The third possibility considered was the creation of a parallel I/O bus system permitting connection of several devices via one interface. Such systems are known specifically in measurement technology (e.g., IMS-2-bus [2]). Because such an interface is extremely flexible and requires only one assembly in the master, this solution was adopted.

Structure of the I/O Bus System

The bus system consists of the following signals (also see Table):

- Communications lines D0 through D7
- Two-wire handshake /DAV, /DAC
- Bus management /MMRQ, /MMAI, /MMAO
- Central reset line /RESET.

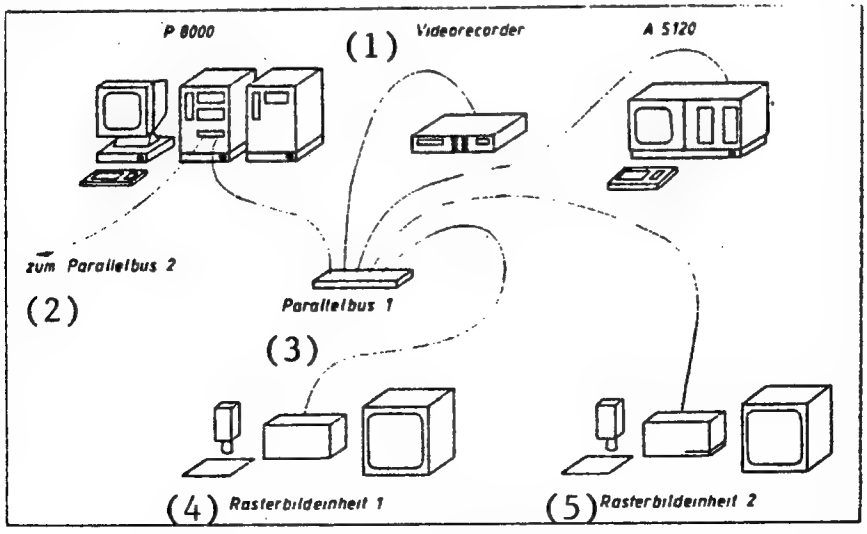

Figure 1. Configuration of the image processing system

Key:—1. Video recorder—2. To parallel bus 2—3. Parallel bus 1—4. Raster display unit 1—5. Raster display unit 2

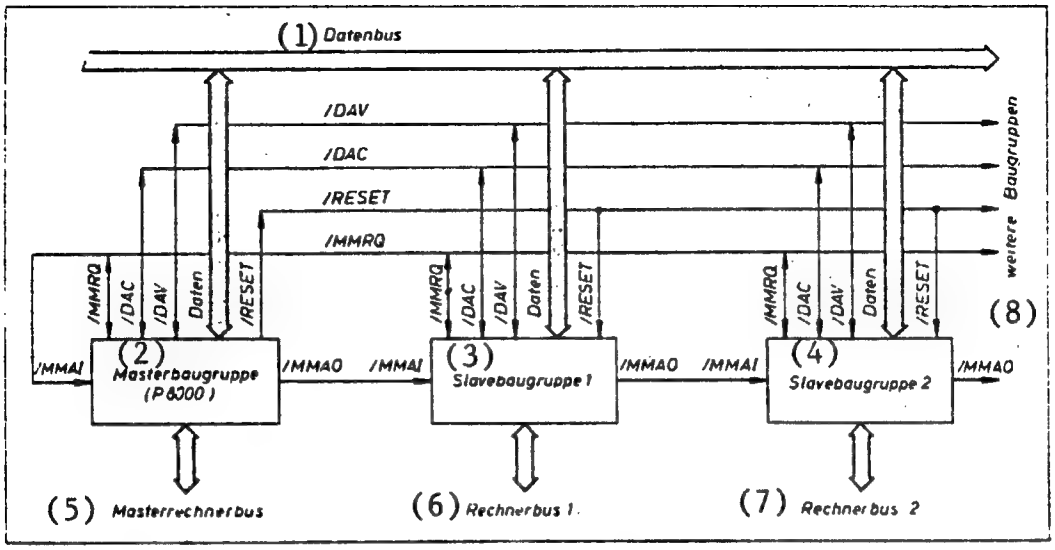

Figure 2. Structure of the I/O bus system

Key:—1. Data bus—2. Master assembly—3. Slave assembly 1—4. Slave assembly 2—5. Master computer bus—6. Computer bus 1—7. Computer bus 2—8. Additional assemblies

Signals of the I/O Bus System

Signal	Receiver	Transmitter	Explanation
DO through D7	Input	Output	Data
/MMRQ	Input	Output	Bus access signal
/MMAI	Input	Input	Priority chain input
/MMAO	Output	Output	Priority chain output
/DAV	Input	Output	Handshake signal
/DAC	Output	Input	Handshake signal
/RESET	Output	Output	P8000 reset output
/RESET	Input	Input	Slave reset input

Figure 2 shows such a bus system with several units connected. Each system can be receiver and transmitter. The principle of the bus allocation was selected in imitation of the design used in the Z-bus because it can be implemented with little hardware expense [3]. The /MMRQ (Multi Micro Request) line is bidirectional, and the /MMAI (Multi Micro Acknowledge in) and /MMAO (Multi Micro Acknowledge Out) lines form a daisy chain connection. In the idle state (bus not in use), the /MMRQ line carries H-potential. /MMRQ is linked with the input /MMAI of the highest priority assembly. All units connect the level on /MMAI through to /MMAO if they are not using the bus or wishing to use the bus. A system requesting the bus first tests the /MMRQ line. If /MMRQ = H, the line is set to L-potential and the bus request is thus signaled. At the same time, /MMAO is kept on H-potential. The bus is allocated if no higher priority system has simultaneously generated a bus request and thus delivered the L-potential via the daisy chain to the /MMAI input of the requesting device. If this in not the case, the request is recycled. With a successful bus request, the desired data transmission may begin immediately. In this case, one block with the following structure is always transmitted:

Module address	(8 bits)
Block length	(16 bits)
User data	(up to 64 K)
Checksum	(16 bit).

The beginning of block transfer is signaled by the bus request cycle. For all units connected, the ground state is receiver mode. The H-L impulse of the /MMRQ signal from the transmitter triggers an interrupt in the receivers. Each databyte sent by the transmitter to the bus is declared valid with the signal /DAV = L (Data Valid) until the receiver signals acceptance with /DAC = L (Data Accepted) (two-wire handshake). With the first byte of the block (module address), the receiver is selected. All other stations immediately terminate their interrupt routine with acknowledgment of an invalid module number without any effect on the bus. After successful block transmission, the sender releases the bus. All functions are monitored for possible time overruns and aborted if error conditions exist.

Assemblies Produced

In addition to a plug-in unit for the P8000, interface assemblies for the USS8000 system [4] as well as for computers with the U880 CPU were produced. The P8000 plug-in unit is detailed below. The peripheral component chosen was the IS U8036 (CIO) counter, clock, and I/O (Fig. 4), which may be connected directly to the multiplex bus of the U8000. For other processors (U880, 8086, 80286, etc.), it is possible to use the CIO

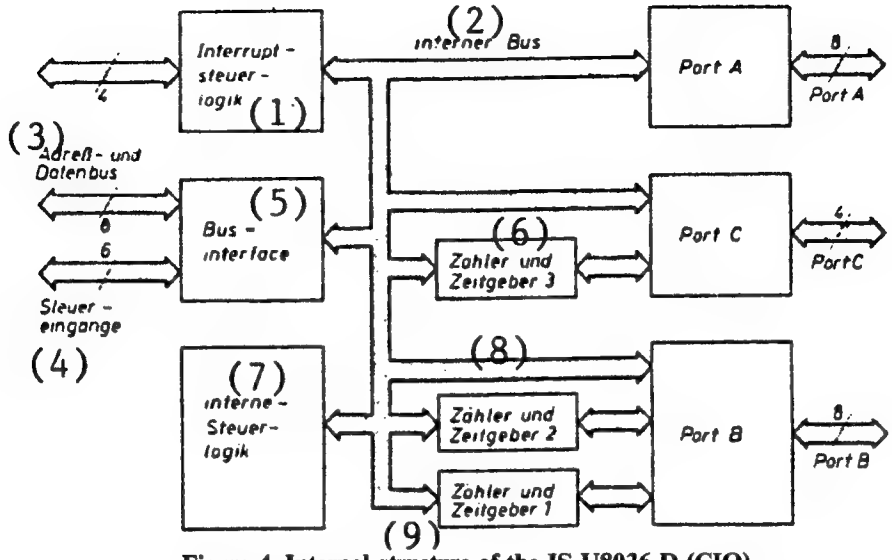

Figure 4. Internal structure of the IS U8036 D (CIO)

Key:—1. Interrupt control logic—2. Internal bus—3. Address and data bus—4. Control inputs—5. Bus interface—6. Counter and clock 3—7. Internal control logic—8. Counter and clock 2—9. Counter and clock 1

U80536 without a multiplex bus. A few characteristics of these high performance CIO's are

- two independent 8-bit-wide, double-buffered, bidirectional I/O ports and a special 4-bit I/O port
- choice of polarity, direction, and impulse
- programmable open drain outputs
- four handshake modes (including two-wire handshake corresponding to IEEE-488)
- REQUEST-/WAIT signal for high speed data transmissions
- flexible pattern recognition logic, programmable as an interrupt controller with 16 vectors
- three independent 16-bit counters and clocks with 4 external I/O's each (counter input/output, gate, trigger input), retriggerably and nonretriggerably programmable
- all registers are readable and writable as well as directly addressable (U8036 only).

Use of the PIO U855 is possible and has in fact been accomplished.

Fig. 5 shows the block diagram of the P8000 plug-in unit. The assembly includes two parallel interfaces and thus permits access to two independent bus systems. The hardware expenditure is low. The interface to the P8000 bus includes a bus driver with directional control, an I/O decoder, and a status decoder. The pulse is negated on the P8000 expansion slot. The interface to the parallel bus consists of a data driver (DS8286) and several logic gates to implement the bus control circuit.

Software Structure

The system design is based on the fact that control of the peripheral units is always interactive. The P8000 system thus acts as master and initiates all functions, including communications between two slave systems. For this purpose, WEGA was used to implement an appropriate interactive system as a control program which accesses the parallel interfaces via special drivers.

The lower driver level is identical or very similar for all stations. This module is programmed in assembly language and includes the following functions:

- Initialize a parallel interface
- Send a block
- Receive a block
- Reset slave (on master only)

Parameter transmission follows the transmission conventions defined in WEGA so that direct integration into higher languages is possible (C, for example). For operation under WEGA, a system-based device driver was implemented; it uses assembler procedures to drive the hardware and can be controlled from user programs via the usual system functions [7]: Open, Close, Read, Write, Position.

In the interest of a higher transmission rate and for direct hardware control, the driver was implemented as a "raw device," i.e., data are input or output directly from the driver without intermediate buffering.

The master triggers the start of an interrupt routine in all receivers with the beginning of transmission via the signal /MMRQ. The module address of the slave addressed which transmitted at the beginning of the block enters the subsequent block into a ring buffer. The transmission is aborted by the arrival of the end of block signal or by an error. A control program which fetches received blocks from the ring buffer is implemented in the slave. Each block contains a header describing the

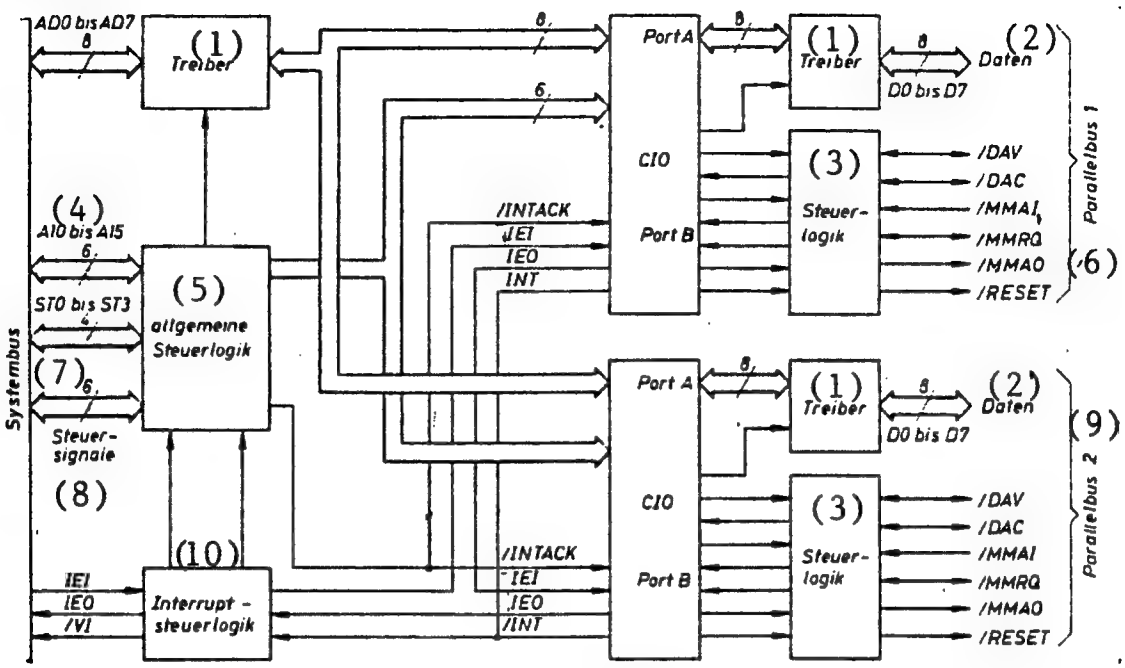

Figure 5. Design of the CIO assembly for the P8000

Key:—1. Driver—2. Data—3. Control logic—4. A10 through A15—5. General control logic—6. Parallel bus 1—7. System bus—8. Control signals—9. Parallel bus 2—10. Interrupt control logic

block and commands to be executed. The control program interprets this header and executes the appropriate commands.

Developmental Environment

With its efficient operating system, the P8000 offers excellent software development capabilities. There are, however, problems with the actual introduction into service of assemblies for the P8000. On the one hand, the physical design of the system permits only relatively poor access to the hardware, and, on the other hand, the internal EPROM debugger is, for example, only of limited value for the testing of interrupt routines. The authors, however, are quite knowledgeable about the use of assemblies for the USS8000 and K1520 systems [5].

So far research has been performed on a target system using an EPROM debugger from the 8-bit developmental system (A5120 under UDOS) via a serial interface (V.24). Because the P8000 now has much more to offer than an office computer, it was used as a host system. For this, an interactive program was developed in C to control any type of developmental hardware (U880, U8000, 8086, etc.) via a printer interface and thus to implement the operation of the EPROM debugger present there with its commands (Register, Break, Display, Move, Compare, Fill, Next, Port, Go, etc.) including file transfer in both directions [6]. In addition, the interactive program supports work with symbols instead of hexadecimal address statements. Thus, programs for all processors available in the GDR may be developed and tested because the P8000 manufacturer supplies cross software (single chip microcomputer, U880, U8000, 8086, etc.).

Testing of the P8000 assembly was performed on a USS8000 system. For this, an adapter card was constructed to generate signals from the GSS bus corresponding to the P8000's bus definition. After the hardware was put into service, the assembler procedures for the driver were also tested there so that the lower driver level and the hardware were functional before implementation of the WEGA driver interface.

Summary

The parallel bus design developed and implemented permits linking of many devices to a developmental system, which may, for example, be used for digital image processing. The developmental tools produced within the framework of this project support an efficient use of the resources of the P8000 for hardware and software development with varied target hardware.

With the hardware and software produced, net transmission rates of 100 kbits/s have been obtained in the exchange of large blocks. This permits transmission of a 256-x-256-pixel image with an amplitude resolution of 8 bits (64 K of data) in less than 6 s.

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FACTORY AUTOMATION, ROBOTICS

GDR: Industrial Robotic Systems Profiled

ROBOTRON PHM-55 System

90CW0087A East Berlin FEINGERAETETECHNIK in German No 11, Nov 89 pp 485-487

[Article by Dr Eng V. Strube and Patent Eng H. Brodkorb, Specialized Robot Development Section, VEB Robotron Rationalization Enterprise, Weimar: "The Robotron PHM-55 SMD-Mounting Robot"]

[Text] In accordance with the international tendency, more and more surface-mountable components are also being used in the GDR for assembly of electronic structural groups. It is particularly the advantages of the small geometric dimensions that permit the user to utilize a higher stacking density of components assembled on circuit boards. Moreover, the structural forms of SMD [surface-mounted diode] components are suitable for automated handling and for installation on circuit boards. It is primarily the advantages of handling SMD components, as opposed to hard-wired components such as resistors and condensers, etc., that predestine them for use in automated mounting systems. In contrast, there is the increased difficulty of manual handling, for example, for small series production or laboratory solutions, which compels the application of technical aids. Furthermore, the physical stress exerted upon manpower engaged in hand mounting of SMD components is very high and, as a result of the monotony of the operation as well as in view of the demand for accuracy in work processes involved in manual installation, this form of installation is hardly reasonable for application in large or medium-size series production. A substantial increase is anticipated in the fabrication and application of SMD components by the year 1990. Accordingly, it is essential that the necessary automation systems be created now, so as to be able to efficiently process these components. The following principal groups of automation systems emerge:

- Automatic installation machines,
- Mounting robots,
- Manual mounting work stations.

With respect to automatic installation machines, these involve special design problem solutions for installation of components on circuit boards, particularly in terms of large-scale fabrication requiring very high installation output. With respect to the mounting robots, suitable and already available assembly robots are generally modified by the addition of special gripper arms to be able to accomplish the task of SMD installation.

This gives rise to more cost-effective mounting robots which, because of their medium installation output, appear to be particularly suitable for medium-size and small series fabrication. Moreover, the characteristics of the robot with respect to its flexibility vis-a-vis the technological environment are retained.

Manual installation work stations complete the spectrum of the automation systems downward and will remain unrenounceable especially for the period of the transition involved in the introduction of production, as well as for small series fabrication.

The mounting robot which is the subject of this article is based on the Robotron PHM-55 assembly robot as the basic tool (Figure 1) [not included in this translation].

1. The Robotron PHM-55 Assembly Robot as a Basic Tool

The Robotron PHM-55 assembly robot is, in terms of its basic features, a swivel-arm robot with four orders of latitude. It has a DSDD structure [1]. The working radius is 600 mm and the maximum workpiece weight is 1.5 kg.

The design of the gripper arm gearing (GFG) can be seen in Figure 2.

An expansion by the addition of two external joints (for example, a round worktable) is possible at customer request. The motion possibilities offered by the individual operating components are as follows [2]:

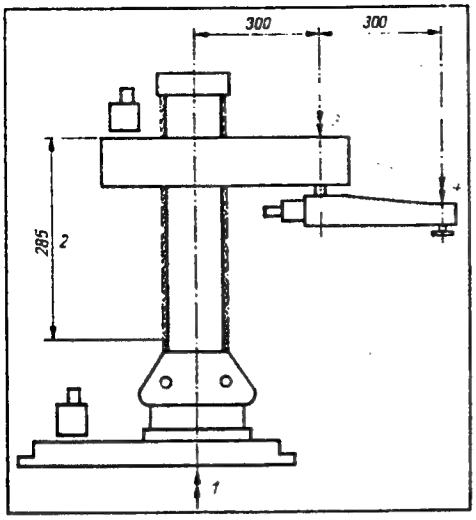

Fig. 2. GFG design of the PHM-55 robot.

Swivel joint 1	330°
Hoisting unit 2	285 mm
Swivel joint 3	330°
Swivel joint 4	n x 360° (n = random)

Depending on the position of the GFG and the gear ratios, an accuracy of resolution ranging from 0.01 through 0.03 mm can be achieved. Drives are step servomotors in micro-step operation, used in a closed control loop.

The following output parameters are achieved:

Swivel joint 1	max 200°/s
Swivel joint 2	max 0.8 m/s
Swivel joint 3	max 200°/s
Swivel joint 4	max 400°/s

For a typical assembly cycle, according to Figure 3, a cycle time of less than 4.5 seconds is required, including a pneumatic gripper confirmation stage.

Controls are based on a dual computer configuration of the K1520 system. The hardware design of the controls can be seen in Figure 4.

The control computer consists of a computer core with a central processing unit (ZRE) on the basis of a U880, 128

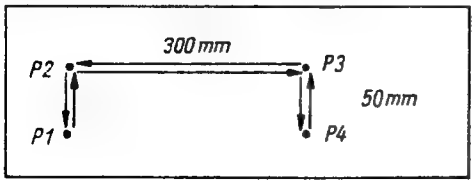

Fig. 3. Standard assembly cycle.

K RAM (OPS) computer with an arithmetic expansion to a 32-bit arithmetic processor (ARP) on the basis of a U8032 computer.

For purposes of tying in the data periphery (keyboard, monitor, floppy disk, as well as teach and operating units (TBE)), AFS, ABS, ASS control units are used. For purposes of controlling peripheral equipment used with the robot, for example, feeder and ejection devices, four sockets for digital or analog input-output cards (IPM) from the assortment of programmable P-6000 controls manufactured by the VEB Robotron Rationalization Enterprise in Weimar are planned [4]. The control circuit module (ASK) handles functions involved in diagnostic support and function control for the computer and for the power source for the controls. The coupling-central processor unit (KZRE) constitutes the computer core of the drive computer on the basis of a UA880 and also handles the DMA traffic between the control computer and the drive computer. The drive computer is subordinate to the control computer, it services the drive units of the individual motor components via its internal systems busbar. The task distribution and the resulting software design are discussed in more detail in [5] [not listed].

Driver motors used are reluctance step servomotors manufactured by the VEB Office Machines Plant at Soemmerda; they are controlled by the ASM motor controls via an output amplifier (LVR). The motors are not operated in the normal way as step servomotors, but the specific control electronics located within the motor control units create a feedback micro-step operation. This results in the achievement of a quasi-continuous operation having 3,840 motor steps per revolution. By using a feedback loop through an incremental signal generator (an IGR-M2-960, manufactured by the VEB Carl Zeiss Plant at Jena), it is possible to control the motors on the basis of the load angle, as well as on the basis of workpiece position, whereby a step loss is eliminated.

2. Specific Expansions Pertaining to the PHM-5.55 Mounting Robot

For purposes of adapting the PHM-55 to the specific requirements involved in installing surface-mountable components on circuit boards, the assembly robot is augmented by the addition of the following modules:

- Installation head,
- Pipette changing device,
- Pneumatic controls.

Devices for the clamping of circuit boards and the placement of components are not contained within the performance parameters of the PHM-5.55 robot.

As a result of the flexible configuration of control units for peripheral equipment, the robot can be used as part of a linear automation line or for the creation of installation cells with automatic or manual circuit board presentation. An appropriate installation cell has been

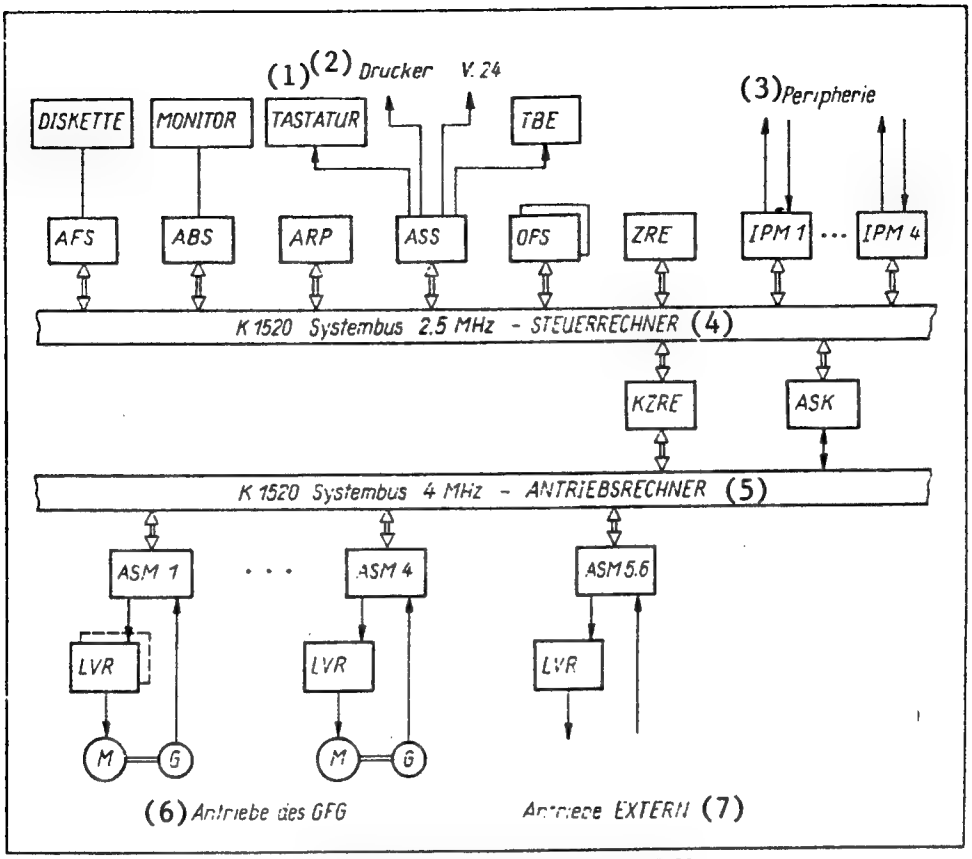

Fig. 4. Control design of the PHM-50.

Key:—1. Keyboard—2. Printer—3. Peripheral equipment—4. Control computer—5. Drive computer—6. GFG drive—7. External drives.

developed by and is offered by the VEB Robotron Rationalization Enterprise at Weimar. The installation head as the core of an SMD-specific expansion is shown in Figure 5 [3]. It consists of a vacuum tube with interchangeable pipettes and two pneumatic drives to activate the pipette stroke and the motion of the centering tongs. Using the vacuum, the pipette suctions the component. The pipette stroke of 12 mm serves to move the component from the level at which it is made available or at which it is stored to the level of the centering tongs. Through the paired symmetrical, but independent closing of the centering tongs, the suctioned component is centered beneath the vacuum pipette and is again deposited on the work surface after the centering tongs open. With the aid of blow-off air, the vacuum in the vacuum tube can be rapidly reduced. The installation head permits the handling of a broad assortment of SMD components. The spectrum ranges from very small chip resistors or chip condensers through SOT, SOD, SO components and through to relatively large chip carrier component forms. To handle various groups of components, different vacuum pipettes are required which have differing diameters and lengths. The changing of pipettes is accomplished automatically with the aid of a pipette changing device.

Starting with the possibilities presented by the IROS-55 operating system, a group of specific robot commands were created to cover the task class of mounting surface-mountable components on circuit boards, with the aid of which simple and clear programming becomes possible. For this purpose, a previously prepared program arrangement is made available to the user. The robot is programmed at two levels. In the first level, the robot is tied in with its work environment, which consists of component presentation, pipette exchange, and circuit board pickup. It is assumed that the work environment or the installation cell remains unchanged for varying installation tasks, that is to say, that the positions of the component tracks for the pipettes and the circuit boards remain constant. These positions are to be determined on a one-time basis in a teach-in process and are to be taken up in the program. Moreover, the type of vacuum pipette to be used is determined for any component supply device placement position. The actual installation tasking pertaining to a special circuit board is programmed at the second level, using the comprehensive installation commands of HOLE (FETCH) and LEGE (PLACE). These commands realize the following functions:

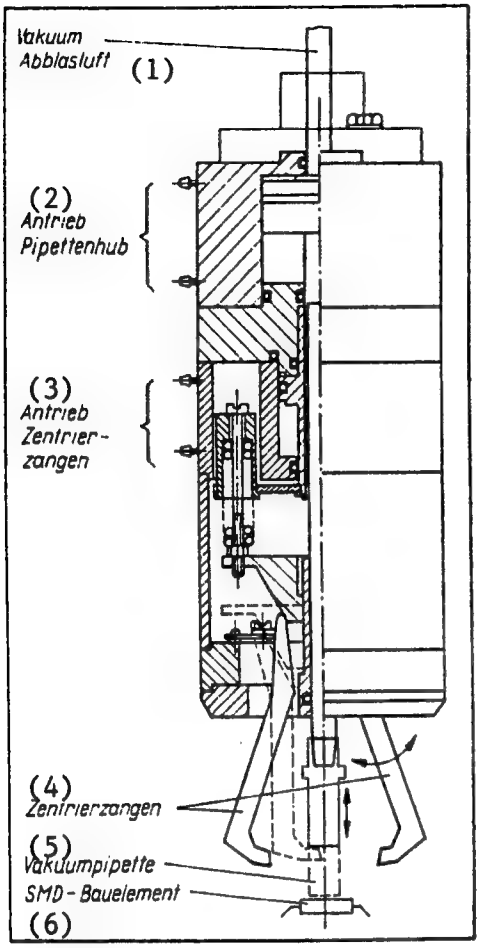

Fig. 5. Installation head for surface-mountable components.

Key:—1. Vacuum blow-off air—2. Drive for pipette stroke—3. Drive for centering tongs—4. Centering tongs—5. Vacuum pipette—6. SMD component.

- HOLE:

1. Control of the type of pipette to be used in the next installation operation and where automatic pipette exchange is required;

2. Movement in the direction of the indicated component supply position;

3. Lower the vacuum pipette;

4. Initiate vacuum;

5. Lift vacuum pipette;

6. Close centering tongs.

- LEGE:

1. Check for presence of component with vacuum sensor and, where indicated, handle as error;

2. Move to installation position;

3. Open centering tongs;

4. Lower vacuum pipette;

5. Vent vacuum pipe;

6. Lift vacuum pipette.

The individual command portions operate in time-parallel manner in part. Thus, for every installation the program line must be written as follows: supply hopper—3 HOLE installation location—17 LEGE.

The HOLE position noted as "supply hopper—3" is permanently located in the installation cell and had already been determined as part of the teach-in process in level 1 of the programming. The LEGE positions, for example, "installation location—17," are first noted as freely selected variables in the installation algorithm and can then be firmly established through learning (teachen) or through numerical indications of the Cartesian position.

When a new circuit board is being devised, only the programming at level 2 need be changed.

Results

Test results showing the following parameters are available with regard to the current status of this development:

Component Spectrum

- chip resistors and condensers of the 0805, 1206, 1210, 1810, 2220 type,
- SOT23, 89, 143,
- SOD80,
- S08, 14, 16, 20,
- CC24, CC18/22.

Cycle Time

A cycle time of less than 5 seconds per component is being achieved. Given favorable conditions as a result of short distances between the component feeder position and a small number of differing components, the cycle time can be reduced to less than 4.5 seconds.

Reliability

Installation experiments have proven an error installation rate of less than 1 error installation per 1,000 components.

Conditions

To assure reliable operation, a good quality of component and circuit board must be assumed. These factors include particularly the following:

- TGL-approved component housings,
- Tolerances between pick-up borings of circuit boards and the circuit configurations must not exceed +/-0.1 mm,

- Unevenness of the presented circuit board must not exceed 0.5 mm.

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PHM-50 Programming System

90CW0087B East Berlin FEINGERAETETECHNIK in German No 11, Nov 89 pp 488-489

[Article by Dipl Eng M. Weingart, VEB Robotron Rationalization Enterprise, Weimar: "Programming System for the PHM-50 Industrial Robot"]

[Text] **1. The PHM-50 Industrial Robot**

The PHM-50 industrial robot, produced by the VEB Robotron Rationalization Enterprise in Weimar is a freely programmable, process-flexible industrial robot which is primarily conceived as being suitable for assembly and workpiece feeding operations. The IROS-50 (Industrial-Robot Operations System) operating system, as part of the SIR-50 control system, has the task of controlling the gripper guide system 50, the gripper with its gripper change system, as well as the user-specific peripheral equipment including any external degrees of free movement.

Since another article in this issue deals in detail with the hardware of the control system, it shall not be further elucidated here.

A description of the total robot is contained in [3].

2. The IROS-50 Operating System

2.1. Characteristics

In developing the PHM-50 robot, there existed the task of creating a flexible and performance-capable real time operating system. In contrast to the predecessor PHM-41 [1, 2], the goal was to detail a great deal in high programming language. It turned out that the FORTH language system was a suitable aid in this regard [4, 5]. Consequently, up to 80 percent of the IROS-50 operating system was programmed in this language. Quite separately from this, all time-critical program portions such as the controls of the robot movements, the various instrument drives, and all error diagnostics were written in ASSEMBLER language.

The IROS-50 operating system resulted in a number of typical characteristics which are particularly reflected in the performance capabilities of the new generation of robots. On a priority basis, the following are identified:

- Textual programming with a possibility of direct and indirect teach-in,
- Possibilities for off-line programming,
- Variable peripheral equipment coupling,
- Voluminous sensor processing possibilities,
- Use of a structured high programming language,
- Expanded user language, depending on technological viewpoints.

A particular advantage lies in the possibility of being able to describe sensor processing functions in a high programming language.

2.2. Parts of the IROS-50 System

Control Module

The control module (Figure 1) contains all of the components necessary for on-line control of the industrial robot, including operating and motion controls. It facilitates the operation of the teach-in, the STEP operation, and the RUN operation contained in the user program and a test operation.

The user program is processed interpretatively after loading the source text and after its compilation, by way of commands. The teaching of various positions is accomplished in conjunction with the programming and control module during the creation of a user program. In

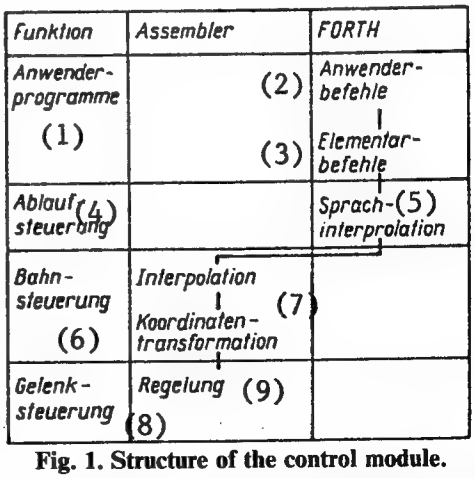

Fig. 1. Structure of the control module.

Key: 1. User programs—2. User commands—3. Fundamental commands—4. Operating control—5. Language interpolation—6.Track control—7. Coordinate transformation—8. Swivel-joint control—9. Regulation

the RUN mode, the controls can accomplish PTP movements, as well as random straight-line motions within the Cartesian world system.

The guidance magnitude generation is handled as an interruption routine in a 20-ms rhythm within the operating controls and operates on a quasi-parallel basis with them. It contains the interpolation as well as the direct and inverse coordinate transformation data.

Movement is carried out via a regulator mechanism which operates at a 5-ms rhythm within the drive computer.

Programming and Control Module

The job of the programming and control module consists of the off-line creation of a user program, as well as playing a supporting role during the activation and testing of operations. For economic reasons, this module is integrated with the controls; however, it can also operate separately on a PC/BC with an SCP operation system (Figure 2).

The core piece of the program and control module is a text editor which is used to produce a source database in the memory, which is issued in the form of a diskette in the SCP format. Within the editor, the teach-in operation can be activated. Since the determination of the spatial positions occurs in the source text format, these positions can be edited, like any other source text. The control module is used for teach-in purposes (directly or indirectly) with respect to positions.

The compilation of a user program can be accomplished either directly from the source text storage or from a diskette. Several databases can be automatically downloaded and translated. Text data which have been produced with the use of other editors (for example, with TP) are equally operable.

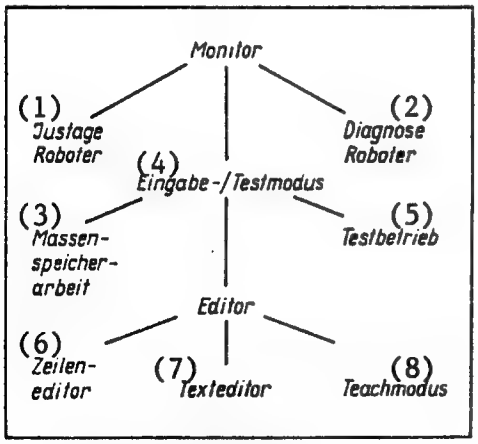

Fig. 2. Components of the programming and control module.

Key:—1. Calibration robot—2. Diagnostics robot—3. Mass storage operations—4.—Input/test mode—5. Test operation—6. Line editor—7. Text editor—8. Teaching mode.

Test operations are accomplished via the PKM with the aid of a line-oriented step operation of portions of the user program.

Error Diagnosis

The separate error diagnostic operating module serves to recognize errors primarily in the computer hardware, as well as in the power supply. Error diagnosis is supported by special components in a control circuit. Error situations in the hardware portion of the drive system are located, in part, component-specifically and indicated to the operator (failure of drive, defective performance amplifier, etc.).

2.3. The ROPS Programming and Language System

The ROPS (Robot Programming Language) already represents a voluminous fundamental command set having around 80 commands which can be further expanded by the user or can be modified. For this purpose, the principle of the open language syntax contained in FORTH was taken over into the user language.

For a more simplified handling by operators who are not familiar with computer equipment, ROPS uses a German-language syntax, which is mostly kept in clear text.

The detailed description of the command set is contained in [6]. The most important commands are compiled in Table 1. Hereinafter, it is intended to elaborate only on some typical command groups.

Table 1. User Command Groups for PHM-50

Command Group	Commands
GFG motion	BEWEGE, BEWS [MOVE, MOVES]
	TEMPO, MOMENT
	SYNCR, LINIE [line]
	ZU, UM [APPROACH, BYPASS]
	STOP
Motion status	RUHE, ZIEL [REST, TARGET]
Gripper confirmation	HAND-AUF, HAND-ZU [HAND-OPEN, HAND-CLOSED]
Gripper sensor	SNGRF
Position definition	DEFR-V: DEFR-D:
	DEFR-K:
Operand definition	DEFO-V: DEFO-D:
	DEFO-K:
Operand treatment	LADE [LOAD]
	X, Y, Z, D
Periphery	DEFIPM: DEFAEE:
	DEFI-S: DEFI-B:

Table 1. User Command Groups for PHM-50 (Continued)

Command Group	Commands
	DEFAA:
	DEFA-S: DEFA-B:
	DEFB-T:
Arithmetic logic	+, -, *, /
	AND, OR, XOR
	>, <, =, NEG
Terminal operation	TEXT, TEXTD, TEXTL
	WERT, WERTD [VALUE, VALUED]
	TONK, TONL
Clock time	UHRD
Waiting time	WARTE, WARTE-B [WAIT-B]
Commentary	()
Program halt	HALT
Structures	WENN, DANN, SONST [IF, THEN, OTHERWISE]
	ENDE-WENN [END-IF]
	WIEDERHOLE [REPEAT]
	BIS, IMMER [UNTIL, CONSTANTLY]
	ABLAUF, ABLAUF-ENDE [OPERATION, OPERATION-END]
Program organization	TABELLE, TABELLE-ENDE [TABLE, TABLE-END]

A programming example covering the palletizing of five identical parts one on top of the other is depicted in Table 2.

Table 2. Program Examples for the Palleting of Five Identical Components One Above the Other, Drawing of These Components From a Presentation Facility, Screwing Together the Palleted Components

Program Pallet DEFR-V: Ausgangspunkt [Outlet point] 43327, 9633, 90112, 63847; DEFR-V: Zufuehrung [Presentation] 45267, 1904, 34371, 60029; DEFR-V: Palette [Pallet] 46575, 20235, 635, 37646; DEFR-V: Ueberpunkt [Overpoint],,3000; DEFO-V: Teil [Part] 0 DEFI-S: Schalter [Switch] 3OH 4 1

ABLAUF Punkt [Discharge Point]

BEWEGE TEMPO 6 UM Ueberpunkt [Move Tempo 6 Around Overpoint]

BEWEGE TEMPO 8 ZU Ausgangspunkt [Move Tempo 8 to Outlet Point]

ABLAUF-ENDE [Operation-End]

ABLAUF Fuegen [Operation-Continue]

WIEDERHOLE [Repeat]

O LADE Teil [O Load Part]

WIEDERHOLE Punkt [Repeat Point]

BEWEGE TEMPO 6 ZU Zufuehrung [Move Tempo 6 To Feed]

HAND-ZU Punkt [Hand-To Point]

BEWEGE TEMPO 5 ZU Palette [Move Tempo 5 To Pallet]

WIEDERHOLE [Repeat]

WENN Schalter DANN STOP [If Switch, Then Stop]

ENDE-WENN [End - If]

BIS RUHE [Until, Rest]

HAND-AUF [Hand - Up]

Teil [part] + 1 LADE Teil [1 Load Part]

BIS Teil [Until Part] = 5 Punkt [Points]

BEWEGE TEMPO 6 ZU Schraube [Move Tempo 6 To Screw]

HAND-ZU Punkt [Hand-To Point]

BEWEGE TEMPO 4 ZU Palette [Move Tempo 4 to Pallet]

HAND-AUF [Hand - Up]

IMMER [Constantly] ABLAUF-ENDE [Operation-End]

Motion Commands

Motion commands are the most typical commands for an industrial robot. In the ROPS language, a motion is initiated by the command "BEWEGE." The user program continues in parallel with the motion. All commands, except for motion commands per se, can then be processed in parallel with the robot motion. This facilitates a very simple use of peripheral reports such as sensor information or allows for parallel periphery control.

A motion command can only be processed if the preceding motion has been terminated. For special applications, however, the command "BEWS" starts a new motion immediately.

The most important parameter of the motion command is a space vector which determines the target position of the gripper as well as the position of the external swivel joints within the world system.

Every space vector is made up as follows:

- X, Y, Z position of the gripper arm route in the Cartesian world system in graduations of 1/100 mm,
- D rotation of the swivel joint in degrees,
- EX1, EX2 rotation of the external joints in increments.

A space vector can be defined by the following:

- A specific numerical value,
- Direct or indirect teach-in,
- Variable magnitudes which can be assigned values on the basis of
- —computation operations,
- —internal sensors (actual position),
- —external sensors (for example, camera).

Positions of a space vector which are not used by the user remain constant as the motion command runs. This makes possible motions in predetermined directions, independent of their starting point.

Further, there exists the command "STOP" with the use of which a running motion can be aborted, for example, as the result of a sensor report.

Data Commands

A series of arithmetic and logic commands facilitate the efficient creation of a user program. Apart from constant values, variables, and literals, the coordinates of space vectors (target and actual positions) and peripheral connections are usable as operands or target magnitudes. This means that, for example, target positions can be computed by movements or set as a result of sensor reports.

All applied data types (constants, variables, space vectors) are to be defined by the program or prior to their use. Within the framework of the totality of the available user memory, their numbers are unlimited.

The user can make use of data structure values in the range of -999999...0...999999 (internal 4-byte integers). Every space vector consists of one vector of four to six of these elemental data.

Program Structures

The ROPS language compels the user to use a structured form of programming, that is to say, leaps in the program are not permitted. This way, even complex programs can be written clearly. Comfortable structural commands facilitate the required branching within the program. Examples of this are the structures WIEDERHOLE [repeat]...BIS [until]... and WENN [if]...DANN [then-]...SONST [otherwise]...ENDE-WENN. [end - if]

Complete command sequences are compiled under one name. The sequence can be called up under this name and can, thus, be used as a new command for the robot language. Using this principle, the available set of commands can be simply expanded by specific technological commands which are added during use.

Peripheral Commands

As a result of the multiplicity of the available input and output possibilities, operating controls are hooked up with the technological periphery by commands which are to be defined by the user. The programming system contains the necessary basic elements for this purpose. The advantage for the user is based on the fact that the physical transformation need only be considered during the definition of peripheral commands. Input/output operation itself is generally subsequently introduced by a freely selectable name on the part of the user. In assigning names, technical viewpoints can be taken into account, which is something that makes the use of the commands easier.

The gripper arm and the gripper change facility are to be considered as special peripheries of the robot. These, like the appropriate sensors, can be addressed directly via implemented "HAND" commands.

Organizational Commands

The organizational commands assist in the documentation and the organization of the program operation.

Terminal commands can be used to program communications for the operator. For specific technological tasks, the use of waiting times or of a "HALT" command are meaningful.

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MICROELECTRONICS

Development Tempo of Bulgarian Microelectronics Increasing

90CW0123 East Berlin AUSSENWIRTSCHAFT in German 29 Nov 89 p 41

[Article: "People's Republic of Bulgaria: High Tempo of Development in Electronics"]

[Text] In the restructuring and technological retooling of the Bulgarian economy, electronics is assuming a leading

role. Thus, in 1988 this production complex alone was responsible for 30.6 percent of the total increase in the country's industrial production, amounting to 5.1 percent, or 2.4 billion leva. The basis for this, in addition to an above-average rate of increase in labor productivity for the sector of 9.7 (overall 8.9) percent, was an 18-percent increase in the output of electronic products (1987: 16 percent) to 5.8 billion leva. Of this, 1.7 billion leva or 29.9 percent was attributed to new or enhanced products.

Developmental Emphases and Orientation

Both in 1989 and beyond, electronics will assume the leading role in the structural modification of industry. This year, manufacturing of electronics and information systems is expected to increase especially quickly to reach a 22-percent share of the total output of electronics products.

With the extremely high tempo within the sector and in Bulgarian mechanical engineering as a whole, the manufacture of technical equipment for microelectronics is to be developed. In this area, Bulgaria is cooperating closely with Soviet organizations.

The strategic development of the sector is taking into account the needs of the Bulgarian national economy as well as the development of electronics and data processing in the other socialist countries, primarily within the framework of the Comprehensive Program for Scientific-Technical Progress in the CEMA countries through the year 2000.

In this connection, for example, a comprehensive renovation of the peripheral memory production project is planned. (Bulgaria has specialized in this field within CEMA.) The removable disk devices produced to date are gradually being replaced by hard disks. Hard disks with a capacity of 10, 20, 31, 121, 317, and 635 MB are already being offered. Within the next 1 to 2 years, production of 300- to 600-MB hard disks should begin.

Also, a program is being implemented for development and manufacture of optical WORM memories, including compact disks for entertainment electronics. Also planned is the development of erasable and rewritable optical memories. To this end, Bulgaria is striving to increase cooperation with foreign partners.

In the microelectronics area, the plan is to increase production of integrated circuits 1.6-fold in 1989 as compared to 1988 and 3-fold by 1990. The use of technologies and equipment for production of 256-Kbit and 1-Mbit memory chips and 16- and 32-bit processors is also to be pushed.

For example, at the beginning of this year, the Combine for Microelectronics Botevgrad introduced the 16-bit microprocessor system SM688, compatible with the Intelsystem 8088.

Production of active and passive components for SMD assembly is currently being prepared for.

The express goal of the Bulgarian components industry is to cover a total of 55 percent of the demand for active components and 85 percent of that for passive components from domestic production by about 1990.

In this connection, a significant expansion of production capacity is also underway. Thus, at about the beginning of 1989, a new printed circuit board plant began operation in Pravez. It is part of the Combine for Microprocessor Technology Pravez and, in the first stage of the project, will meet the combine's demand for printed circuit boards. By the end of 1990, it should reach full capacity and use only CAD/CAM technology for development and production.

Within the framework of the industrial synthesis of single silicon crystals with diameters up to 200 mm and a mass of 60 kg, scientists at the Bulgarian Institute for Solids, working with the Soviet physico-technical Joffe Institute, developed a special system with which substrates with ideal surfaces for microelectronic integrated circuits are obtained. To develop these technologies and begin their production, an international laboratory has been created in Plovdiv. Before the end of this year, a production plant for highest purity crystals for electronics is to begin operation.

In the area of microprocessor technology, the greatest growth rates are planned for systems based on the personal computers (PC's) and microcomputers produced at Pravez.

Thus, among other things, the Combine for Microprocessor Technology Pravez introduced its first 32-bit PC, the Pravez 386, as a desktop model at the 44th International Trade Fair Plovdiv '88. It is based on the 80386 processor, which can be expanded using a 80287 or a 80387 coprocessor. The 1-MB-RAM can be expanded to 10 MB. The ROM has a 128-KB capacity.

The 16-bit computers in series production at Pravez have a 640-KB storage capacity. Both diskette and hard disk technology are used for data storage.

Much attention is being directed to the networking potentials of computers in local area networks (LAN's). For example, at the show organized jointly with Isotimpex in February of this year in Berlin, the Pravez Combine offered 5 LAN's, including the mircoring LAN MicroSTAR. MicroSTAR has star configuration and permits connection of 8 PC's to the central node. Successful work is also being done on the development of computer networking systems with the relevant systems software. Offerings include microprocessor systems for education and training, health services, the building industry, production and control management systems all the way to expert systems such as Cortech, a system for the control of technological processes, and Agrotech, an expert system for agrarian technologies.

In the array processor field, the Bulgarian firm Incmos occupies a leading position among the socialist countries. The array processors currently offered by Incmos have a performance rate of 12 million floating decimal operations per second. Production of a new model with increased performance and a smaller footprint as well as array processors for minis and micros is in preparation.

Currently, systems are being produced by Incmos using minicomputers, array processors, and specialized software, with which performances of 100 million operations per second (MIPS [million instructions per second]) are obtained. Work is underway to achieve a performance of 500 MIPS by year's end.

Overall, the objective of the Bulgarian microelectronics industry is unmistakably to provide increasingly complete user solutions. A key position in this is occupied by the Enterprise for Software Products and Systems (SPS) with approximately 1,500 employees. In cooperation with other partner companies, SPS is undertaking development of client-specific hardware and software solutions. At the Plovdiv '88 Trade Fair alone, SPS's offerings consisted of more than 180 displays, including 172 program solutions.

Other dynamically developing areas of the Bulgarian electronics industry are optoelectronics and laser technology. Laser technology production should increase in 1989 by more than 70 percent over the preceding year. In 1989 alone, approximately 460 laser systems are to be installed, including 380 in the health field, 66 in industry, and 10 in the building industry.

Bulgaria has increasing capacity in the optoelectronics field, especially for optical fiber and cable intended primarily for the production of fiber optic connection systems, devices, and components for communications electronics.

SCIENCE & TECHNOLOGY POLICY

GDR: Technological Lag of 2-8 Years Reported

90CW0097 East Berlin NEUE ZEIT in German 19 Dec 89 p 5

[Article by Siegfried Wagner: "Technological Lag of Two to Eight Years; Many Mistakes Made in GDR Microelectronics Development"]

[Text] The GDR currently has a less than 0.4 percent share of the world's production in the field of microelectronics. Ten years ago, the figure was 0.8 percent. It is highly probable that GDR production in this industry will continue to drop in the 1990s, because production in Japan, South Korea, China and other Asiatic countries—and increasingly in Western Europe as well—will increase so rapidly that the low production volume in the GDR will necessarily result in an even smaller percentage of the world's production volume. In a study by the Academy Central Institute for Economic Sciences, the authors come to the conclusion that in the future, the GDR will be able to play only a participatory rather than an influential role in international trends.

In order to evaluate production results in the field of microelectronics in the GDR, they must be objectively measured on an international scale, said Dr Wolfgang Marschall, who headed the study. For example, an examination of circuit production alone, as measured on a per-capita basis, shows that the GDR currently lags unacceptably far behind leading industrialized nations—a gap which a concentration of all efforts should be able to narrow to five to six years. Professor Marschall also said that another significant factor is the gap in the level of technology with respect to memory circuits and microprocessors. Initial prototypes of new memory circuits would be available in the GDR, he said, if leading manufacturers can reach a series production figure of ten to twelve million circuits per month.

The technological gap in the semiconductor device industry in the GDR is between three and eight years. This is the equivalent of one to three generations of technology. At the same time, current yields in the GDR do not match the customary international standard. These factors are the cause of a severe economic lag in circuit production. The costs per transistor function, for example, are roughly a factor of ten higher than the international standard, in view of the drastically sinking market cost of device types which are important in the performance of pre-production activities. Professor Marschall made reference to most recent investigations which indicate that preliminary work in the production of integrated circuits in Japan is realized 70 times more efficiently than in the GDR.

Scientist Marschall is of the opinion that in past years, semiconductor device production, and in particular the production of DRAMs (dynamic, random-access read/write memories), has received to much unilateral attention: Roughly 50 percent of all investments in microelectronics, he said, were made in this area. Professor Marschall indicated that it was a mistake to concentrate efforts only on certain memory circuits to the extent that they then "stick out" as indicators of progress against a background of lagging overall technology. Current production of memory circuits in the GDR, Dr Marschall feels, is also very expensive and thus uneconomical, as evidenced by high subsidies for semiconductor devices.

The necessary division of labor, as seen internationally, has been employed with too little consistency in the GDR, Dr Marschall said. A high level of production for the domestic market had been viewed as desirable, and was considered a goal to be pursued; imports from non-socialist countries were to be replaced wherever possible. This orientation simultaneously meant moving away from the international division of labor as a productivity factor. Today, the various forms of international cooperation in the field of microelectronics are becoming more and more evident around the world.

It is wrong to establish microelectronics as a relatively independent branch of the national economy, and to retain the traditional structure of the GDR economy in its entire breadth, despite the considerable subsidies it requires. Today, the material and technical base of many of the traditional sectors of the economy is hopelessly outdated, according to Dr Marschall. In view of the fact that it will not be possible to bring all of these economic sectors up to the same level of modernization, structural changes cannot be avoided. In the GDR, those sectors in which the potential of microelectronics can be best utilized should be developed above others; these include the machine tool, scientific instrument, textile machine and printing machine industries, for example. It is of great importance, according to Dr Marschall, that attention be given to the variety of products manufactured by the microelectronics industry during a structural reordering of the national economy. There should be a trend toward the development and manufacture of a greater number of application-specific circuits and a reduction in the number of standard circuit types. The level of technology reached can be used for this purpose. Standard circuit types are now available on the world market at lower prices than could ever be achieved by GDR manufacturers.

Dr Marschall sees an increased international division of labor as a significant factor in the future development of the industry—a division of labor which cannot be limited to CEMA member nations. In the past, those responsible for state planning have failed to adequately support international activity, and have not paid enough attention to international market requirements. The GDR can break through embargoes only by engaging in true cooperation. Professor Marschall mentions one example which he considers feasible: "We allow international capital into the GDR market—for example, in joint ventures in which it is possible to bring our technology up to the level of the most advanced technologies."

TELECOMMUNICATIONS R&D

Czechoslovakia: Telephonic Automation of Eastern Region Completed

90WT0021A Prague TELEKOMUNIKACE in Czech No 10, Oct 89 p 150

[Article by Eng Pravoslav Valny, East Bohemia Administration of Telecommunications: "Areal Automation in East Bohemia Kraj Completed"]

[Text] Telecommunications on the territory of the East Bohemia Kraj are divided into two transit telephone circuits. The transit telephone circuit [TTC] in Hradec Kralove includes 18 central telephone exchanges and the TTE in Pardubice 15 central telephone exchanges.

In 1960 only two in a total of 33 central telephone exchanges [CTC], and only 18 in a total of 169 local telephone exchanges were automated.

Since 1960 and particularly after 1970 our telecommunications have expanded rapidly. Telephone communications have been fully automated in 169 local telephone exchanges [LTE]. The number of connected telephone lines exceeded 300 thousand. As compared with 1960, private telephones increased more than 20-fold—to 101,750. Every fifth residential unit in this kraj is furnished with a private telephone.

Decimal exchanges Nos III and IV in Hradec Kralove and Pardubice, telecommunications facilities in Chotebor, Havlickuv Brod, Svitavy, Policka, Hlinsko, Novy Bydzov, Jicin, Vrchlabi, Turnov, Nachod, Broumov, Nove Mesto nad Metuji, Vysoke Myto, Rychnov nad Kneznou and Dobruska, and the facilities for a transit telephone exchange in Hradec Kralove and in Pardubice have been built in our kraj since 1960.

The construction of technological facilities expanded the capacity of state telephone exchanges. Furthermore, the new capacities made it necessary to build both the long-distance and local telephone networks.

The construction of the transit telephone exchange in Pardubice began in July 1980. The principal contractor was the Prumstav [Industrial Construction] in Pardubice. During the construction there was a certain "freeze" in favor of construction projects with higher priority. While the construction was underway, the building was declared the Kraj's Youth Construction Project III and despite all difficulties, the project of exemplary quality was finished by the Prumstav in December 1986.

The whole construction project is divided into five departments:

* Service building—locker rooms, storage rooms, dining room, kitchen, cafeteria, computer center, the workers' union, radio center, workrooms.

* Technological building—its only purpose is to house the technological equipment; in it is the local and transit exchange with appropriate equipment for related technical operations.

* Power center—supplementary power source, exchanger, chemical water treatment, engine room for the cooling system, and transformer station.

* Underground garage—space for 24 service vehicles; parking lot is located on the roof.

* Radio telecommunications tower—with a 7 x 6.3 m base, 86 m high, with platforms for parabolic antennas.

Plans were drafted by the Strojprojekt [Engineering Planning] in Prague.

Chief subcontractors for the construction project were the Kovopodnik [Metal Works] in Pardubice, Stavebni izolace [Building Insulation] in Prague, Kutna Hora and Hradec Kralove, the OPOS in Chrudim, Stavomontaze [Construction Assemblies] in Pardubice, and ZUKOV in

Prague. Other contractors who undertook the finishing works were the CKD [Czech-Moravian Kolben Danek] in Horovice, the Adast [Adamov Constructions] in Adamov, the TUS [Technical Center for Communications] in Prague, and Eram in Hradec Kralove.

The No 2 construction project of the building complex of the telephone exchange in Pardubice is the 5th +PDS/US 2 +Sl.S. decimal exchange in the PK202 system. In addition to improving telephone operations, this local exchange will make it possible to add more party lines for the inner city and for the "Zavod miru" [Peace Works] housing project. Its costs amount to Kcs 67 million; the exchange has 10,000 line capacity, and its two-wire stage has 1,250 lines attached.

The No 3 construction of the building complex is the Transit Exchange proper. Its costs amount to Kcs 184 million; its communication system is ARM201/4, and its current capacity is 5,400 lines with potential expansion to 8,000 lines. The chief contractor of technology is the BHG of Budapest, and the contractor of assembly works is the MPSP [Communications Assembly Enterprise] in Prague.

The No 4 construction project of the building complex is the switchboard and the expansion of the local transit exchange in Pardubice at the cost of Kcs 17 million.

The last—No 5—building of the construction complex is a long-distance central in Pardubice which cost Kcs 75 million.

The above-mentioned building complex is connected with auxiliary facilities and annexes; the investor is the East Bohemia Administration of Communications. Furthermore, there are constructions of the Long-Distance Cable Administration in Prague. This whole project in its totality represents financial outlays of Kcs 630 million.

It was not a simple task to put such an extensive project in operation. Before that could be successfully done, good planning preceded, all participating organizations had to be coordinated, and a joint international socialist contract had to be concluded with a Hungarian contracting organization. During the construction new methods of economic management were put to test: a change from methods of volunteer teamwork in labor organization to a higher form of khozraschet management of operations and production centers was made with the use of computer technology.

The change itself was divided into two stages with an interval between them. The first stage (early July 1989) included the launching of operations in decimal exchange No 5, the switching of 4,300 participants to a new exchange, and a number of adjustments in the local network. This task took three days and for it the East Bohemia Administration of Communications engaged the assistance of assembly units from every district administration of communications in the East Bohemia Kraj. The eighty workers who participated in this endeavor received specifications of their individual tasks in a graphic form. The time-table for individual tasks was correlated so as to keep the interruption of services to customers as brief as possible. The dedication and achievements of the assembly workers were truly exemplary.

In the second stage (late August 1989) the telephone exchange began its test run and was integrated in the unified telecommunication network.

25 August 1989 was a historical date because on that day the automation of local and long-distance operations in all of the East Bohemia Kraj was completed whole five years ahead of the schedule stipulated by the task for the long-range development of communications in our kraj. The users of more than 158 thousand telephone lines gained automated local, long-distance and international services. In terms of our national economy, direct automated telephone connections is of particular importance to users in the northern and southern parts of the East Bohemia Kraj. Direct automated connections in international communications with 28 European and 9 non-European states are now available to users of the telecommunication circuits of Pardubice.

The test run of the telephone exchange in Pardubice started on 6 September 1989 and on that occasion a meeting of the builders took place at it, the first deputy minister of transportation and communications of the CSSR, Eng Jiri Jira, director in charge of the state enterprise Administration of Post and Telecommunications in Prague, Eng Jiri Necas, director of the East Bohemia Administration of Telecommunications in Pardubice, Eng Josef Lnenicka, and the general director of the BHG in Budapest, Kalman Kovacz, honored the workers who had contributed most to this building and to the launching of operations in the transit telephone central. Appreciation is due to all workers, assembly workers, foremen, engineers and planners who throughout the planning and construction proper worked honestly and with dedication to put such an extensive project in operation and to public service.

Czechoslovakia Evaluating S12000 Interconnecting Telecommunications System

90CW0073A Prague TELEKOMUNIKACE in Czech No 10, Oct 89 pp 157-159

[Article by Eng Vaclav Volf, Research Institute of Communications, Prague: "The S12000 Digital Private Branch Exchange"]

[Text] **The planned growth of private branch exchanges cannot be realized without the application of electronic communications systems. The number of private branch exchanges within the Unified Telephone System is expected to grow to encompass virtually 3 million subscribers by the year 1995.**

Currently, the S12000 digital private branch exchange, manufactured by the Yugoslav firm of ISKRA at Kranj,

which makes possible the establishment of telephone exchanges handling approximately 240 through 8,000 subscribers, is undergoing evaluation. The exchange was placed in operation in November of 1988 and, as of March 1989, it has been undergoing test operations. The article discusses the basic characteristics of this system and the experiences gathered in preparing to utilize the above-listed system within the Unified Telephone System, as well as experiences gathered during test operations.

Characteristics of the System

The Model S12000 exchange is a telecommunications system in which modern and technically progressive principles are applied:

- digitalization,
- hardware and software modularity which facilitates future systems innovation,
- distributed program control.

Proposed circuits make use of elements which have a high degree of reliability and which guarantee economically efficient operations and maintenance.

The system is comprised of functional modules (Fig. 1), with each making up an independent hardware and software unit. Peripheral modules are mutually connected to the central group switch module (GSM) in a star-shaped configuration. Connections with each of the peripheral modules are handled via a 32-channel 8-bit parallel primary multiplex for the transmission of voice signals and a 32-bit series channel for interprocessor communications. Voice channels are connected in the single-stage T-type field. Interprocessor communication is handled via the transparent commutation of signals by the GSM control unit. A central processor is not required to process calls. The functions handling operations and maintenance are supported by an administrative module (ADM) and a charging module (CHM) takes care of billing. Where the commutation of data is necessary, the system can be augmented by the addition of a data commutation stage for packet transmission (X.25), which will facilitate communication between various

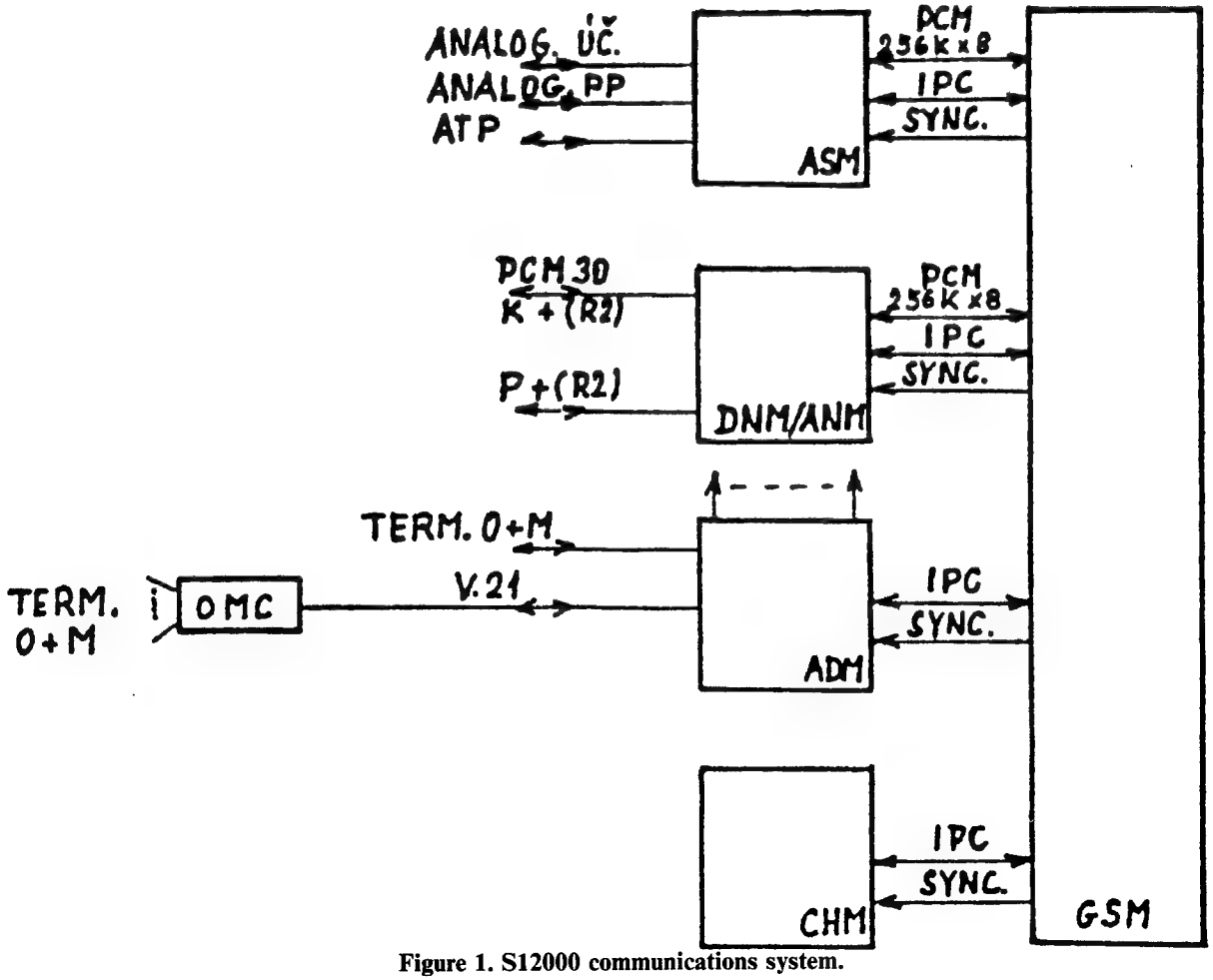

Figure 1. S12000 communications system.

types of terminals, computers, and with the public or private branch data network.

The Czechoslovak Telephone System anticipates using the S12000/124 variation of the system which makes it possible to create telephone networks.

Central Modules

The GSM (Group Switch Module)—a digital group selector—supports three fundamental functions:

- It facilitates the commutation of 32 peripheral 64-kbit modules with channels without internal blocking.
- By using the interprocessor communications protocol, it can communicate, via the GSM, with a maximum of 36 modules through the IPC interface.
- A central time base, which provides the possibility for external synchronization, transmits synchronizing pulses to the peripheral modules.

The GSM 32-group selector makes it possible to establish branch exchanges to handle up to approximately 8,000 subscribers.

The ADM (Administrative Module) is the module that handles servicing and oversight. The servicing and oversight module contains a cassette tape unit which houses the program for the system and is used to introduce the program to all modules of the exchange. The ADM has an attached servicing and maintenance terminal (an image screen and a printer).

The CHM (Charging Module)—the tariff-computation module—serves as the central installation for the processing of tariff data. Data are recorded on a cassette tape unit of the same type as the one used in the ADM module. Preprocessed tariff data, recorded on magnetic tape, can be utilized either directly or, depending on the requirements of the user, can also be processed on an external computer.

Peripheral Modules

The ASM (Analog Subscriber Module)—the module for analog subscriber groups—is made up of a basic block of a 1 ASM, which contains the controlling module processor and of central function units, as well as of one or two auxiliary frame-type blocks of a 2 ASM. The set of 1 ASM + 2 ASM has a capacity for a maximum of 144 connections (0.17 E/subscriber). A set of 1 ASM + 2 x 2 ASM has a maximum capacity of 240 connections by lowering the average operating load per connection to 0.1 E. Within the module, group codes to handle 32 voice channels are used, as well as an analog concentration stage for 240 subscribers/32 channels (vertical), which is made up of electronic switching matrices. Apart from being able to make connections with its subscribers, the ASM can use its special vertical connecting facilities to connect a maximum of 16 analog carriers (public, semiautomatic, and transverse) and can also make connections with subscriber positions at two ATP work sites. The above-listed design solution makes it possible, when the GSM interface is omitted and after adding a power source, to have the ASM act as an independent small private branch exchange with a capacity of up to 240 subscribers (Model S12000/014).

The ANM (Analog Network Module) facilitates the connection of 32 analog carriers with direct access to the communications field, without concentration. It is anticipated that the carriers will be used along with P signals in both directions, either with decadic dialing or MFC-R2 signals. The module can also accommodate carriers for private branch networks with pulse signals or constant signals.

The DNM (Digital Network Module) makes it possible to connect a PCM30 digital tract via the RM1 interface. The DNM comes into being from an ANM by omitting the analog interfaces. The ANM and the DNM modules can use a maximum of 16 KPV's for MFC-R2. K line signals in the DPM make use of the 16-channel KI interval according to recommendations of the CCITT.

Design

The S12000 system utilizes only high-quality components purchased from reliable suppliers (three independent world-class producers): logic circuits in HCMOS or FAST technology, memory circuits dynamic RAM 256 k x 1, static RAM 8 k x 8, EPROM 32 k x 8, 5057 codec/filter, 8870 receiver for subscriber frequency dialing, CMOS 8-bit microprocessors, VLSI 2-Mbit PCM interface circuit, etc.

The manufacturer guarantees less than 1 defect per 100 connections per year. The power requirements of the system do not exceed 1.5 W/subscriber in any case.

The installation is mounted in standard frames measuring 1900 x 400 x 600 mm. The maximum capacity of a frame is six modules + a heat deflector at the center of the frame. Functional frames are stacked in stacks having basic dimensions of 220 x 250 mm. An advantage of the system is that it uses only 6 types of modules and 20 types of circuit boards, something which is favorably reflected in service requirements and in maintenance.

Conditions for Cooperation Between Medium- and Large-Capacity Private Branch Exchanges in the Unified Telephone System

Medium- and large-capacity PbUs (of the S12000 type) are concentrated particularly at SMTO-TU's, where public and private branch digital communications systems will likely be used first. By 1995, we are talking about 600 private branch exchanges.

A correctly chosen strategy for incorporating private branch centrals into the public telephone network is an important condition for achieving good-quality operations within the Unified Telephone System. It is, therefore, necessary to begin preparing for the introduction of PbU's in developmental plans covering the telephone

network (dimensioning, through-dialing and numbering plan, attenuation plan, preparations for digitalization of the network, etc.).

The processing of a high operational load of PbU's primarily requires that use be made of attaching PbU's to the group calling stages of public telephone central offices. On a priority basis, it is necessary to introduce through-dialing using MFC-R2 signaling. If group calling stages are also equipped with PbU outgoing cables, savings can be had in public central offices in terms of additional equipment, for example, registration equipment, UON devices, etc.

The load on communications stages in the public local telephone network can be reduced by the direct connection of large private branch exchanges to the central telephone office of a higher level in the network (for example, a junction central office or a long-distance central office). In rural-type telephone exchanges, large private branch exchanges can represent independent MTO's in terms of the telephone network configuration and in large city networks, they can represent tens of associated stages, etc. The entire junction telephone network, including private branch exchanges, can be established as a single central office within the SMTO, by using digital communications equipment, with satellite centrals located in the OMTO. These possibilities, which are unrealistic for the time being from the standpoint of existing regulations, must be considered as long-range and as being economically efficient.

It is advantageous to connect large private branch exchanges of the analog as well as digital type to the public telephone central office with the assistance of digital tracts. Savings are achieved in the equipment of central offices, in communications circuits, the attenuation of communications is lowered, and future digital circuits within the telephone network are expanded and will, later, become the basis for a digital network.

The above strategy of incorporating PbU's can be applied in incorporating the S12000 system into the Unified Telephone System. Apart from current types of signaling which are suitable for collaboration with the public telephone network, this system makes it possible to use P + R2 and K + R2 signals at the RM1 interface in both directions. The supplier—ISKRA at Kranj, also offers a muldex as a component of the PbU (possibly also including a digital tract) with carriers using U as well as P signals to work with analog public central offices. It is anticipated that the assortment of carriers will be further expanded to accommodate private branch networks. P signals permit the PbU to have Czechoslovak-produced long-distance dialing connected to them—for example, for direct connections with the long-distance exchange.

When used in the analog network, the S12000 system makes it possible to compensate for the attenuation of attached circuits.

The cooperation of private branch exchanges in making connections to the VTU group calling stage will require certain adjustments in the equipment at public centrals or possibly also a program or different carriers which have, thus far, not been realized. What is involved here are outgoing circuits from the PbU, using P + R2 signals or possibly K + R2 signals, which must be supported by simultaneous recording of tariffs at the PbU as well as at the VTU, there is the problem of identification, of cooperation among MFC registers of private branch exchanges with the PK system in transit calls passing through the E10 exchange, etc.

Incorporation of the Test Exchange in the SMTO Ostrava

A test exchange with a capacity of 4,000 subscribers (10 frames) is mounted in a container in an area measuring approximately 4 x 2 m. It is attached in the incoming cascade direction to a PK202 group stage at the 3d decade (direction 361—60 circuits with decadic through-dialing) and to the PK202, P51 subscriber stage at the 2d, 3d, and 5th decades of the local network (161 outgoing and two-way circuits). Making use of 40 transverse circuits with Sn signals, it cooperates with three private branch exchanges. Semiautomatic operations are handled by four switchboards, located together with the HR and the power source for the system in the telecommunications building of the enterprise. The attenuation of the attaching circuit bundle to handle through-dialing was partially compensated for in the ANM module (by approximately 5 dB).

The exchange is equipped with a maintenance terminal, a display terminal, and a printer to register defect reports and statistical data. Tariff data are preprocessed by the charging module and are recorded on magnetic tape which is further processed according to the requirements of the user on a user-supplied personal computer.

According to operational loading, power consumption is within the range of 46-56 A/52 Vss (at-rest consumption of power is 2,000 W + 2.5 W for every activated subscriber loop).

During the second stage of development, it is anticipated that the exchange will be expanded to 8,000 subscribers, that the exchange will be installed in the telecommunications building in space liberated by the present UTU private branch exchange. Attachment to the Unified Telephone System will be accomplished by the use of 10 first-magnitude digital tracts—PCM30, to be hooked to the group calling stage of the PK202 system at the 3d decade (K + R2/P + R2 signals in both directions of communication). The GSM communications field for 32 modules will be replaced with a field for 128 modules.

Maintenance in operations will be supported by employees to be trained at the producing enterprise by changing replacement circuit boards and by repairing circuit boards provided by the manufacturer.

Evaluation of Test Operations

The quality of operations of the test exchange is evaluated according to the following data:

- on the basis of statistical data provided by the "Call-Mix" communications system;
- on the basis of operations monitoring;
- on the basis of defect reports provided by the diagnostic system or possibly by users of the private branch exchange.

In outgoing operations—calls made to the public network (receipt of the dial tone from the public exchange), the success of contacts is virtually 100 percent. Incoming automatic operations based on through-dialing are also virtually 100-percent successful. Failure to get through occurs as a result of the nonuniform congestion of carrier circuits and as a result of overloading the attaching circuit. In the case of incoming semiautomatic operations, the success rate for making connections can be estimated at better than 95 percent (incoming calls to individual work sites are registered summarily, independent of the type of connection made).

The success of connections with respect to the carriers having through-dialing (ITC) was checked at random by use of a device which signaled when circuits were busy, when calls were made, and when calls were completed. In the case of semiautomatic carriers, operations were monitored with the aid of an SAPI-1 computer, which had been adapted to read the duration of calls. In both cases, for purposes of control, use was also made of call monitoring. Internal calls and outgoing operations where error test results and actual operations experience indicated that problems did not arise were not monitored. In monitoring the through-dialing circuit, defects were detected and eliminated in test circuits of the attached PK202 exchange, as well as defects in circuits which substantially increased the error rate within the HPH. In the private branch exchange, it was necessary to adjust some of the power and time values of the hardware as well as the software for the activation of the c-wire and to be able to accept the dialing. This was primarily a matter of suppressing the influence of the testing circuits of the PK202 before the c-wire became busy and the question of parasite pulses transmitted from the PK202 system prior to the transmission of the dialing. Also, minor errors are occurring only at irregular intervals anymore, particularly during the switchboard phase at the work site (transfer to nighttime operations, interruption by the operator, situations in which the operator or the subscriber party does not answer).

In view of the overloading of the incoming circuit with direct dialing, the services of "Do not disturb" and "Not present" were rescinded for incoming operations and it is anticipated that they will be used only for internal operations.

For the time being, hardware defects which were detected as a result of test operations have been evaluated through the middle of August 1989. The results indicate that an average of less than 1 defect per 100 subscribers per year (about 70 percent) was recorded in conjunction with the ZTP at the test exchange. It is realistic to expect that substantially more favorable values will be achieved by the elimination of repeated defects (pushbuttons at work sites).

The low number of defects detected by the automatic diagnostic system or possibly by statistical methods looms as a shortcoming. The manufacturer will be solving this problem during the second stage of the evaluation.

The mounting of air-conditioning units on the face wall of the container proved to be unsuitable in the face of the higher summer temperatures and the efficiency of air-conditioning units had to be increased by temporarily removing their outer coverings. The maximum local temperature (temperature is measured at two points) attained 38.5° C (maximum permissible temperature is 40° C).

The Plan for S12000 System Innovation—Most Immediate Innovative Steps

In 1990, the GSM-128 with a capacity of 128 peripheral modules is to be introduced into production. The maximum capacity of the system will thus be expanded to approximately 18,000 connections. The GSM-128 block will already be used during the second stage of evaluation. Voice channels, channels for intraprocessor communications and for synchronization will, at the same time, be combined into the standard PCM30 interface so that two pairs of conductors will suffice to interlink the GSM and the peripheral module. This, simultaneously, presents the possibility for the direct connection of the digital tract with the GSM without the DNM modules and the opportunity to create subscriber groups which are removed from each other by distance.

In 1991, it is anticipated that the digitization of subscriber groups will be introduced. The ASM module will be replaced by a single-story universal line module (ULM) with a capacity for 240 connections utilizing 16-fold multiples of subscriber sets at the DPS. The capacity of one frame will be a maximum 1,440 connections. Technologically, it is expected that flat assembly will be introduced and that VLSI circuits will come into use. With respect to innovation, the compatibility of the equipment available at original exchanges is anticipated. In this innovative step, the introduction of a center for remote monitoring (OMC) is anticipated.

Innovations Planned for After 1992

Innovations planned for after 1992 are aimed at creating a so-called business communications system (BGS) which includes the joint commutation of voice and data signals and the introduction of ISDN services. These are changes of a fundamental nature. The GSM module will be replaced by a central communications stage designated as a Hyperswitch, which will make it possible to attach not only all existing modules, but modules for

ISDN services and IDN services as well. For interexchange communications, introduction of the CCITT No 7-type signal is anticipated. The time plan is as follows:

- the year 1992—Hyperswitch and No 7-type signal;
- the year 1993—ISDN services—basic approach 2B + D16, primary approach 30B + D64;
- after 1994—additional ISDN services.

All of the above programs of development will correspond to the ISDN standards according to the CCITT Bluebook.

Summary

The results of the evaluation thus far of the S12000 system are positive. Advantageous operating characteristics of the system have been proven, that is to say, small requirements for space (less than 0.002 m^2/subscriber), low power requirements of the system, not exceeding 1.5 W/subscriber, and the small number of defects. The prospects for the system are also hopeful and make it possible to utilize it in the digital network.

In comparison with known systems, the S12-B, the MD110, or the TELIC2600, and similar ones, it is possible to evaluate the S12000 system as being at a good level.

During the second stage of evaluation of the S12000 system, the GSM-128 will need to be verified and collaboration between the digital tract and the PK202 group calling stage for outgoing and incoming operations remains to be tested.

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